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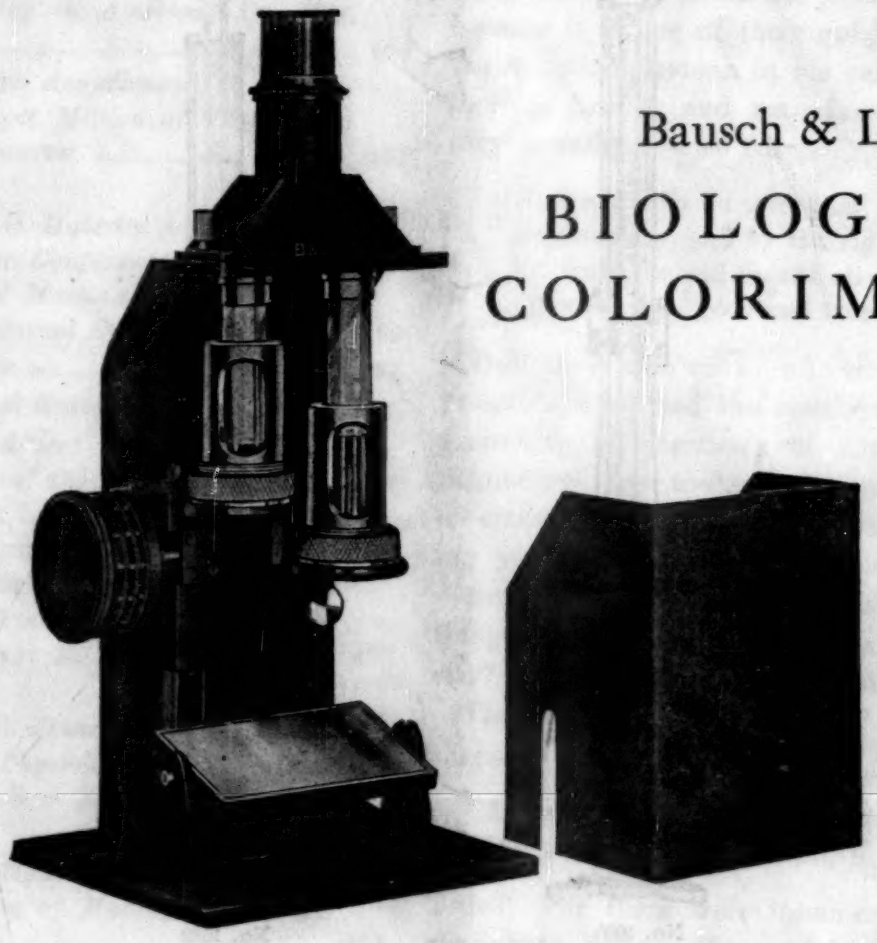

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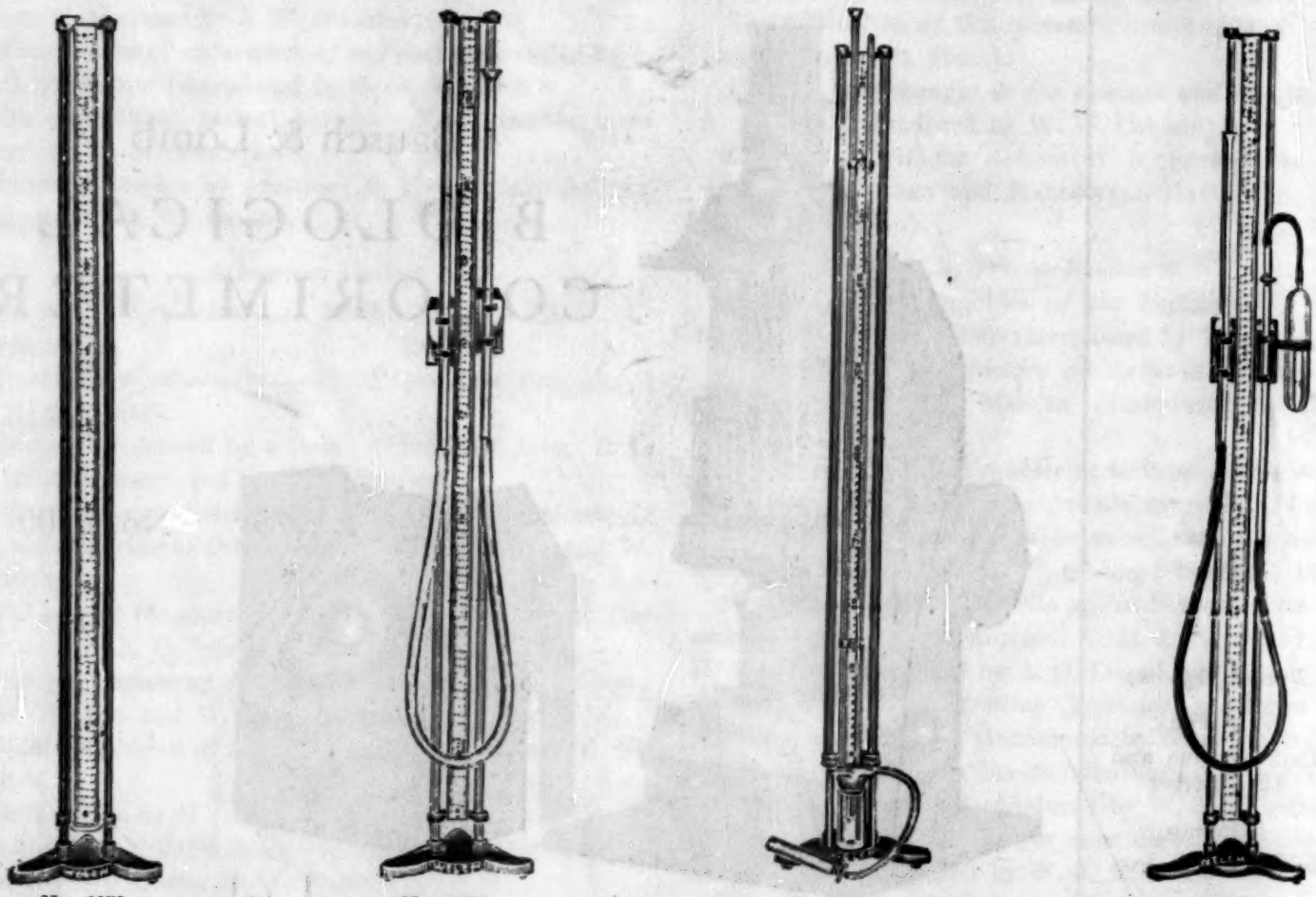

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SCIENCE

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Science News x

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ADDRESS AT THE EDWARD HART CELEBRATION[1]

THIS is a grand occasion, yes, that and much more! And those gathered here are happy. Especially is this true of the chemists in the audience, because it is one of their guild whose completion of the fiftieth milestone in his career as teacher, investigator, printer and manufacturer is at hand, and they proudly rejoice for

> Judge him by no more than what you know
> Ingenuously, and by the right laid line
> Of truth, he will indeed all styles deserve
> Of wise, just, good and true!

But they who've so affectionately arranged this assemblage advised the speakers of the hour to tell something of chemistry in America. Heeding this injunction—free to descant on any phase of the huge, all-embracing subject—this particular speaker, craving your sympathetic indulgence, will hie him back—pretty far back—into the past, for there are some things which "if gathered from the ashes of obscurity" prove interesting, illuminating and worth while.

The wily Subtle, in Ben Jonson's "Alchemist," shrewdly said:

> All arts have still had, Sir, their adversaries;
> But ours the most ignorant,—

True! For there were innumerable, unconscionable charlatans among the professors and practitioners of the alchemic art, whose shameful practices brought the craft into general disrepute. They were the *adversaries* of the simple, sincere devotees who had learned to scorn delights and live laborious days in search of the all-powerful transmuting agent, yet not blind to other new and marvelous changes occurring in their crude, primitive furnaces. Nor did these enthusiasts live in European lands alone. They existed here in America. We who've taught chemistry probably never knew this. We imagined that our science, freed from its early shackles of ignorance, and superstition, proudly stalked through the land untouched, untainted by those "close deeds of darkness, that shun the light!"

No, it is recorded that John Winthrop, the younger, erstwhile governor of Connecticut, living in New London, somewhere in the late sixteen hundreds, used to resort with his servant to Governor's Ring—a

[1] Address delivered on the occasion of the Edward Hart celebration at Lafayette College, October 16, 1924.

mountain in the northwest corner of East Haddam, and after spending three weeks in the woods of this mountain, roasting ores and assaying metals and casting gold rings, he used to return to New London with plenty of gold.

Governor Winthrop was an alchemist and an intimate correspondent of Sir Kenelm Digby—first alchemist in England in his day! Such is the legend on one side of the shield; turn it, and the inscription reads:

> This same Governor Winthrop—the Younger—found plenty of cobalt, which he made into smalt—used in the beautiful blue and China ware. He sought for and obtained zinc, antimony, copper, mercury and iron. Furnaces for the reduction of ores of iron were erected and operated at his command near his home in Connecticut. Winthrop cherished the desire to aid and improve the arts among the people of his Colony.

And there were other respectable alchemists scattered throughout the land now known as the United States. Indeed, they were here—or not far from here—over in the blue mountains of the Lehigh where the people were all the time dreaming of mines and sudden wealth; the German settlers particularly helping to keep the strange hopes alive. Even the farmers, having brought with them their stories of Kobolds and mountain sprites, and treasures lit, declared that in the winter night—"beneath that arch of unmoved and eternal lights"—they still heard the hill homunculi working and knocking—saw the tell-tale flames, but unluckily could never discover the spots where the mysterious activities described were enacted. Who knows—who dare deny—but what these activities in by-past times, occurring through this beautiful valley, were in some intangible way busy when in July, 1778, Robert Levers said that "the price of iron at Chelsea forge [right here in Easton] was 200 pounds a ton, an advance of 100 per cent. on the price paid by the State a short time previous," and informed "the Council of Easton that Bar-iron could probably be sold to blacksmiths in the neighborhood at 300 pounds a ton."

However, perhaps enough has been said of the alchemists in our land. Their memories should be cherished and passing thought, at least, be given their endeavors, for the latter are truly part of the evolution of civilization in this western world.

In 1683 William Penn, eager for the extension of the reputation of his province, wrote enthusiastically to Lord North of "the minerals of copper and iron in divers places." And, close thereafter (1698) Gabriel Thomas stated in writing that iron had lately been found which far exceeded that in England, being richer and less drossy; copper—far exceeding ours, being richer, finer and of a more glorious color, and further observed:

> Backward in the country lie the mines, which is copper and minerals of which there is some improvement made already in order to bring them to greater perfection. And they will be a means to erect inland Market Towns which exceedingly promote Traffic.

And wise James Logan, secretary of the province, had it impressed upon him

> To remember the mines which the Governor makes yet a secret, even to thee and all the world but himself and Mitchell.

These thrifty, far-seeing, worldly-wise improvers of the alchemical methods adopted to oblige mother earth to reveal her precious treasures were confronted on the way, from time to time, by annoying obstacles and hindrances. Thus, the assembly of the province was petitioned in 1723 by the proprietors of iron works to prohibit the retailing of liquor, except cider and beer, near their works to the workmen!

The picture may now be slightly changed. It is in the last two decades of seventeen hundred. Chemistry, the science, was fast gaining place. Intelligent people realized that, in the revolutionary days, it had rendered a service which could not easily be measured. Even the immortal Washington during his severest military activity had paused to test the toxicity of gases, observed issuing at frequent intervals, from creeks and rivers in which his horses and men had slaked their thirst. All the while he was alert. On the restoration of peace he studied the little industries springing up through the infant republic. Franklin, the practical, had passed on, so Washington, intensely interested and eager, sought by every means to promote the welfare of his people. Wide reading, conversation and correspondence had brought to his attention that in the darkest hours of the Reign of Terror and in the later years when France was growing into a mighty power among the nations of Europe, there was a chemist—Chaptal by name—who had executed most remarkable things; among others, the building up of far-reaching industries based on chemical principles. Chaptal's fame had extended to many lands, whose rulers vied with one another to gain his services. At the time, there were men in America who had known Chaptal personally or had learned to know him through his remarkable writings and books, bringing the new gospel which scholars proposed to offer to industry. These men it was who urged Washington to win Chaptal for America. The result of the effort is told in Chaptal's autobiography:

Finally, the celebrated Washington, then President of the United States, wrote me twice on the subject. In the first letter he made this statement: Although I am the President of the United States, I have not the power to enter into an agreement with you in regard to salary; but useful men, such as yourself, are not abandoned in my Country. Come, and you yourself will be more than pleased by your welcome.

Chaptal did not come.

No doubt there has been in every one of us the unexpressed wish that he might have been about in those early days of the republic, for there is no question that the launching of chemical industrial projects was much on the minds of the people. They were industriously engaged in making nature's products useful, and in the language of old Dr. John de Normandie:

When we want the testimony of experience, a chymical analysis is the best means of investigating the truth.

As one turns the pages of old newspapers, peering into every column and corner, facts appear which illuminate the path of our progress in civilization. Thus there came to the speaker's attention that in 1793, in Philadelphia, one John Harrison was manufacturing oil of vitriol with much success, and was also the first person to attempt the production of nitric acid in the United States. The city directory of that period reveals John Harrison, as druggist and *aqua fortis* manufacturer. But greatly encouraged by his development in the chemistry of these acids he abandoned the apothecary and drug business, so that in the directory of Philadelphia for 1806 he was set down as *chymist* at 75 North 5th Street.

America is greatly indebted to this Englishman—John Harrison—who conducted the vitriol industry with marked ability. All this led naturally to an extension of his activities into other fields of chemical manufacture, with which he had familiarized himself, and which he was enabled to do by the aid of educated foreigners such as Abraham Kunzi, a Swiss, and others. In those days this country was overrun with foreigners, some of whom had been merely laborers in laboratories abroad, with no knowledge of chemistry as a science, and whose skill was confined to their own limited routine work. However, there were men of higher character, of competent education as chemists and of much intelligence. Such were John Farr, Gerard Troost and Eric Bollman. The last of these—Eric Bollman—did a neat piece of work for Harrison, who, like others in those days, concentrated his vitriol in large vessels of glass. The particular favor done for Harrison consisted in working bar platinum into sheets more than 13 inches square, then applying those sheets to the making of a platinum still, weighing seven hundred ounces, with a capacity of 25 gallons, which was employed for acid concentration, by Harrison, for fifteen years! Bollman, a most interesting individual, was indeed a chemist. He plated copper and iron with platinum, and with ease prepared the silver-colored metallic luster or glaze for porcelain with its oxide. Our early chemical books quote him freely. His knowledge had, of course, been acquired in foreign countries. He had won his M. D. degree at Goettingen in 1794 and it was there, under the guidance and inspiration of J. F. Gmelin, the chemical historian, that he had acquired his love for chemistry, his knowledge of which was augmented by travel years in France, Austria and lands where the science was conducted by masters.

Bollman was a Dane with a powerful and versatile mind. He was a political economist and scholar. His writings on economics gave old Dr. Thomas Cooper much concern, and yet these two men were singularly alike in many respects. There was in both a turbulent, radical, revolutionary spirit. Both were members of the Convention in the French Revolution, and Bollman after banishment to this country was, in 1806, deeply implicated in the conspiracy of Aaron Burr. His complete absorption in scientific pursuits developed after coming to this land. His earlier adventurous career had afforded little opportunity for deep thought. Considering the many contributions of Eric Bollman to the infant chemical industries of this country, perfectly well satisfied that they possessed great merit and accelerated old and inspired new undertakings, one conversant in a measure with this extraordinary man's mental predilections is not shocked or even surprised, but merely intensely and sympathetically interested, on hearing for the first time that Eric Bollman and a young American accomplice actually ventured to rescue General Lafayette from close confinement in the prison into which he had been cast in Olmutz, Austria, because of his supposed connection with the insulting degradation and subsequent death of the royal family of France. The recital of this stirring event would probably weary you. But, don't forget that the chief actor was a brother chemist—one who subsequently stood among the first of our American fathers in the science. The escapade, as narrated in old journals, such as the *Edinburgh Annual Register,* is most thrilling! It failed, and those engaged therein were incarcerated, gaining freedom only after the intervention of Napoleon! Think for a moment—we sit in the shadow of a college whose patron saint was Lafayette, once idolized by an enthusiastic populace, raised to the chief command of his emancipated coun-

trymen; then proscribed and hunted by associates; a fugitive in a foreign land, obliged to seek an asylum amongst his enemies, after combatting for the cause of liberty under the banners of Washington, and lastly, seized as a traitor and delivered up to the Emperor of Germany, who threw him into prison, from which one of our craft, Eric Bollman, risked his all and suffered unspeakable torments, that he might set free the idol of his young manhood!

Even chemistry has had its romances.

Other pictures might easily be sketched before you. Their novelty and their display of technical skill would promptly arouse earnest thought and profound mental absorption. But they would lead us far afield. The line of demarcation between past and present would fade into nothingness, and those interested would be surprised and yet happy to hear that the War of 1812, with the commercial restrictions preceding it, caused such a scarcity and dearness of the more prominent and valuable substances, so that one may safely declare the reestablishment of chemical manufactures dates from this time (1812). Foreigners conversant with chemical procedures in German, French or English factories were among the very first to undertake these ventures. Capitalists among our own druggists engaged this foreign skill that their own works might again be brought into operation, so that ere long factories for the making of Prussian blue, Scheele's green and other pigments, and heavy chemicals were quite rapidly inaugurated; hence 93 years ago thirty chemical establishments were in operation in the United States, with an aggregate capital of $1,158,000 and an annual output valued at not less than $1,000,000. Those fostering these undertakings had heeded the injunction of the chemically wise:

> Thrust in thy sickle, and reap; for the time is come for thee to reap! The harvest of the earth and factory is ripe.

And thus runs the story of our science with its many divergent lines. We cherish it, for experience has told us "to hold each strange tale devoutly true."

And how are we to adequately express our joy at the achievements of our friend whose fiftieth milestone in the cultivation of his favorite science is now reached? We have followed him through all his years as student, teacher and industrialist. We've rejoiced in his success, known to the world, and observing his still youthful step—his keen interest and intelligence in the multitudinous activities on every side, we're sure he contemplates even greater things in the coming years. So we'll content ourself by saying—

> Press on, true soul!
> Thou wilt win the prize.
> Thou wilt reach the goal!

University of Pennsylvania Edgar F. Smith

FIFTY YEARS OF CHEMISTRY IN AMERICA[1]

We are accustomed to thinking of our country as young, and so it is when compared in point of years with China. Its beginnings were extremely modest and its future to those who founded it must have been very doubtful, in spite of their courageous optimism. It took years to establish even an approximately firm foothold and a great many more years to solidly establish the position. When we look back upon the work of the early comers we can not but admire their dauntless courage, their industry, their thrift, their prudence. Our whole nation was built upon these and similar virtues, and I hope it will never come to pass that the uneasy quest for what is glibly termed progress will tempt us to look elsewhere than to eternal verities for the real progress of the nation.

Our forebears with everything to do and very little to do it with recognized the supreme importance of educating their children, and very early in their history institutions of higher learning were established. As they progressed with the building of a nation, the need of education became more and more clear, and institution after institution was founded, usually with very slight means, in order that higher education should advance and be more generally obtainable. One hundred years ago, Lafayette College was thus established, and you are to-day celebrating this fact with commendable pride and exultation. The history of the college has been a splendid one and its future is assured. Its long list of honored teachers and distinguished alumni is a visible sign of the success of its work. Its influences, however, which are not visible and are not even known, can not be measured. I congratulate the college on its history and on its work.

During the last half of its life, a man has been associated with the faculty who has made his mark not only within these walls, but outside of them. It is not my purpose to go beyond my text and deliver a eulogy of Edward Hart, but I desire to add my testimony to that of many others who have known him well during that time and appreciate his faithfulness, efficiency and singleness of purpose, happily joined with a saving sense of humor. The college does well in celebrating at its centennial time the semi-centennial of this worthy man's connection with the institution.

It is appropriate in honoring this man who, during the fifty years, has been constantly teaching chemistry and adding to its theoretical and prac-

[1] Address in connection with the celebration of Professor Edward Hart's fifty years of continuous service in the department of chemistry, Lafayette College, October 16, 1924.

tical knowledge, to consider what fifty years have done in this country for the science of chemistry and its application and what chemistry in turn has done for the country. Some of us can look back to the beginning of the period, as we so often do, not only with a feeling of amusement at what existed then but with astonishment at what has happened since. It is true that all branches of engineering and scientific knowledge have progressed tremendously hand in hand, but I think it must be admitted that chemistry has not only done its share but has greatly helped the other sciences to achieve what they have done. The whole progress has been colossal, but I wonder when Professor Hart's centennial is being celebrated whether the chemists of that day will not look back upon us of to-day with the same feeling of amusement at our lack of knowledge and the expensive mistakes which we have unwittingly and ignorantly committed.

In discussing fifty years of chemistry in America, there are so many points of view that the subject can not be covered within the limits of a short address, or even within the limits of a five-foot bookshelf. The historical side, the teaching side, the scientific side, any one is so full of interest that all deserve especial consideration. It is my purpose to speak briefly on the technical side without attempting anything in the way of dates and figures which in themselves would take up all the time allotted to me, besides being very dry hearing. I will lightly touch on a few of the high spots, realizing that there are very many which I will not even mention and realizing also that those I do mention are not complete or likely to be within my lifetime. I have seen a great many chemical problems solved, but I have never seen one that was solved so completely that there was no room left for improvement. Having this in mind, it would therefore be useless to attempt chronological order, and of course it would be foolish to endeavor to align them in the order of merit or importance, as no one can tell how the unimportant things of to-day may become the great and vital things of to-morrow.

I have always called sulfuric acid the pigiron of technical chemistry. Its uses are innumerable and its importance is vital. Fifty years ago this industry was practically in its infancy. Nothing was known beyond the simple chamber process, and no two manufacturers agreed as to the standard content of H_2SO_4. 66° acid ran all the way from 66° to 65°, or even less. The discovery of petroleum and its refining soon showed the importance of a standard high strength. For a number of years, the improvements in the chamber process, including concentration to 66° Be, and a trifle higher, were continuous and more or less secret. The revolution came when an acid of much higher strength—fuming acid—was needed in the arts and therefore had to be produced. A London firm, as far as I can ascertain, was the original producer in a large way of fuming sulfuric acid, by what is known as the contact process. When the requirements of the coal tar dye industry in Germany indicated need of something as strong as what was known as Nordhausen acid, but necessarily much cheaper, this firm exported it to that country. This condition could not last long, as the requirements were too large and too important. Many of you will remember the remarkable paper of Kneitsch which demonstrated the fact that investigators in Germany were alive to the situation and met it splendidly. It remained, however, for this country to develop the best process for the manufacture of this highly important material which lays at the foundation of our own needs for the treatment of certain petroleum distillates, for the great dye industry which has developed here, for high explosives, and unhappily for the manufacture of poison gases which "man's inhumanity to man" brought so prominently and unexpectedly before us during the World War. Fortunately for all these purposes, and others to which I will not allude, the production of fuming sulfuric acid in this country had become larger in 1914 than in any other country in the world and, I think I may add, more efficient.

In considering sulfuric acid, we should not lose sight of the brilliant work done by Herman Frasch in unlocking the tremendous sulfur deposits in Louisiana and Texas. Enormous quantities were known to exist, but until Frasch discovered the way, no one was able to economically withdraw them from their resting place. Thanks to Frasch, to-day the output is enormous, the process well understood and our country is placed far in the lead of the rest of the world in the production of this absolutely necessary chemical.

Another accomplishment must be mentioned, namely, the production of soda ash by what is known as the Solvay (or ammonia-soda) process.

While it is true that this process was conceived sixty odd years ago, its great improvements and refinements have taken place during the last forty years. To-day soda ash is made almost exclusively by that process and has been brought to an astonishingly cheap cost of production if we may judge by its selling price. When we consider the importance of the industries which have been fostered on the strength of this cheap and pure chemical, we must give the process a high place in the accomplishments of the last fifty years.

Petroleum and its distillates come strictly under

the head of chemicals. This whole industry has been developed practically during the last fifty years. Fortunately, the first petroleum discovered was of a comparatively simple composition and methods for its refining were soon devised. The growth of the demand for these products and the discovery of oil in many different localities, all with different compositions, made the problem more complex and more interesting. The difficulties of the industry were greatly increased by the lack of balance of the demand. As an example, I will mention an interview I had with one of the high officials of the largest refining company, during which he told me of the extreme difficulty of disposing of the lighter fractions. What the people wanted was kerosene and lubricating oils; what they didn't want was gasolene. He told me he was at his wits' end to know what to do with gasolene. A few years later I had another interview with the same official and he told me the trouble now was to get gasolene enough. As you know, the invention of the internal combustion engine revolutionized not only the oil industry but a good many others, but what made the internal combustion engine possible? Various devices, including cracking, were resorted to, in order to increase the production of that fraction which a few years before had been a drug. Fortunately, this key industry is much better understood to-day than even twenty years ago, and I have no doubt that those engaged in it will be equal to the problems which the future has in store, and these are both numerous and difficult.

Fifty years ago, by-product coke ovens were in their infancy. Coke was made in beehive ovens, and everything in the coal, except the coke, was lost. The by-product ovens, as the name indicates, made available a good deal of the wealth which had been so carelessly wasted and to-day give us large volumes of illuminating gas, ammonia for the farmer, benzene, toluene, naphthalene, etc., for the dye-maker, tar for the roofer and road-maker, and of course the coke which was the primary objective.

During these fifty years another astonishing thing was done which had a most dominating influence upon the electrical industry in all its branches. I allude to the refining of copper by electrolysis—an industry which has assumed majestic proportions and furnishes nearly all the "red metal" used in the world. Long after Professor Hart came to Lafayette, little was known of the metallurgy of copper, and no one knew how to analyze it without an error sufficiently large to make the industry in its present state impossible. The producers of copper and its ores, realizing this fundamental difficulty, wrote to a number of chemists to see if it were possible to suggest a method of analysis which would be absolutely correct and therefore enable one chemist to check another. The accepted method was worked out in a Long Island laboratory and was based upon the idea that all the copper in an ore or other substance could be electrically deposited upon a platinum cathode, and its increased weight after the copper had been deposited would show the actual weight of the copper in the given quantity of material under consideration. This method with certain refinements to increase its accuracy has been in use ever since. The question was naturally raised, if you can thus deposit a gram, you can deposit a pound or a ton, or a thousand tons, and this was the foundation of the electrolytic copper industry. Being put into practice, another fact was developed which was not noted in the laboratory when dealing with small quantities. The mud which settled at the bottom of the electrolyte was found to contain all the silver and gold, platinum, palladium and other valuable impurities contained in the ore, in more or less minute quantities. The recovery of these residues has saved to the world many hundreds of millions of dollars of gold and silver which otherwise would have gone forth as impurities in the copper. Electrolytic copper itself, on account of its extreme purity, has rendered valiant aid to the working out of the complex problems of the electrical engineer and research worker. Of this period, therefore, we have to record that the electrolytic copper industry of the world and all that that implies was born in a chemist's laboratory and brought up to its present state of efficiency with little delay.

We all remember Sir William Perkin's discovery of mauve, the importance of which does not seem to have been appreciated by the inventor himself or by any of his countrymen. The study of what led to the great industry of coal-tar dyes and organic remedial agents was left largely to the Germans, who seem to have appreciated the importance of the work and made good use of the start they acquired. The by-product coke ovens had made the raw material available for large operations, cheap sulfuric acid and soda ash were also obtainable, but the German chemists are entitled to great credit for what they did with these factors. The war brought to our attention with stunning force the fact that an industry of vital importance for both peace and war had been allowed to get into the hands practically of one nation. Fortunately, necessity being the mother of invention, we in this country met that problem man fashion and have worked it out in a manner deserving the highest praise. This is not the time or place for a disquisition on the importance of synthetic organic chemistry, but it is a very appropriate place to say that in the future we need have little fear that

our country will fall behind in the great procession. Given a pressing need, and the American chemist has never been found wanting in the past, and this to my mind is abundant augury for the future.

One of the most recent triumphs of chemistry is the practical solution of that essential problem—the fixation of atmospheric nitrogen in a form that enables us to use this lazy gas in some of its very active and energetic combinations. Nature has supplied unlimited quantities of it in the air we breathe, and during eons of time has fixed some of it in such familiar substances as coal and nitrate of soda. But to man it was impossible to utilize this vast storehouse of wealth, although it was realized that in time it would be imperative that he should do so. The first partially successful attempt was by Bradley and Lovejoy in their little experimental plant at Niagara Falls. They proved that under certain conditions the nitrogen of the air could be chemically united with its oxygen. Like many another pioneer, they pointed to a fact, but could not make the knowledge lead to a financial success. Their work, however, made others think along oxidation lines made possible by electrical discoveries, and to-day Norway's remarkable hydro-electric conditions yield the world large quantities of nitrates. The oxidation of atmospheric nitrogen became therefore practicable where electric power is cheaply installed and where other uses for it are lacking. In a country like our own, with factories on all sides demanding power and willing to pay much more for it than the nitrogen industry can possibly afford, I do not see any likelihood of the successful establishment of the electric arc process here in spite of all we read about Muscle Shoals. But it is a pleasant task to state that the fixation problem was solved, even if what seemed to be a better way came later.

And what is this better way? Professor Haber and his associates found that nitrogen would unite with hydrogen, in the form of ammonia, under high pressure in the presence of that "still small voice" of chemistry, a catalyst. Ostwald found that with another catalyst, the hydrogen could be easily displaced by oxygen, making nitric acid, and there you are! These two facts made the great war certain, and extended it three years longer than it otherwise would have lasted. Professor Haber told me recently that his attention was attracted to this matter and the possibility of its solution when visiting the little plant at Niagara Falls to which I have alluded. "Behold, what a great matter a little fire kindleth."

We are not behind in this vital question in our own country. One plant has been in successful operation for more than three years, and others are starting. If, unhappily, war conditions should arise, we have the patriotic satisfaction of knowing that the materials for carrying on war are all within our own borders. This knowledge should go a long way towards preventing the necessity of thus using our resources, but it is nevertheless a pleasant thing to know that they exist.

Naturally, the peace uses of nitrogen are far more important and pressing. Peace is our usual condition, thank God! and war is a hideous excrescence which should be and will be made impossible, if not by the improvement of human nature, which is the best way, then by the advance in scientific knowledge which may mean the suicide of the race—a silly alternative.

I have briefly touched on a few of the revolutionary accomplishments of applied chemistry, during the last half century. There are many more. While the chemist can point to them all with pardonable pride, he will not, I am sure, forget the important assistance rendered by the engineer. The problems have been large enough to require all sorts of talent for their solution—another instance of the value of cooperation.

In view of what fifty years have accomplished with, at the beginning, very little knowledge shared by comparatively a few men, what may not be expected of the next fifty years with present knowledge possessed by a vast army? There is abundant room for the imagination. I will venture only one prediction. The most elaborate and delicate chemical works ever devised is the human body. Much has already been done by the chemist in delving into its secrets. Positive results have been obtained which have almost annihilated certain diseases and modified others. I predict that during the next half century, the chemist, working hand in hand with the physician, will discover the origin and nature of most of the enemies of the human body, notably that arch-enemy, cancer, and not only alleviate their effects but absolutely prevent their sinister operations. Then indeed will the human race be relieved of some of its heaviest handicaps, and be freer to progress towards the light of truth which is its principal business, for we have it on the highest authority that "the truth will make you free."

WM. H. NICHOLS

NEW YORK, N. Y.

MEMBERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE PER MILLION OF POPULATION IN THE UNITED STATES

SOME results of a study of the geographical distribution of the membership of the American Association for the Advancement of Science, with special

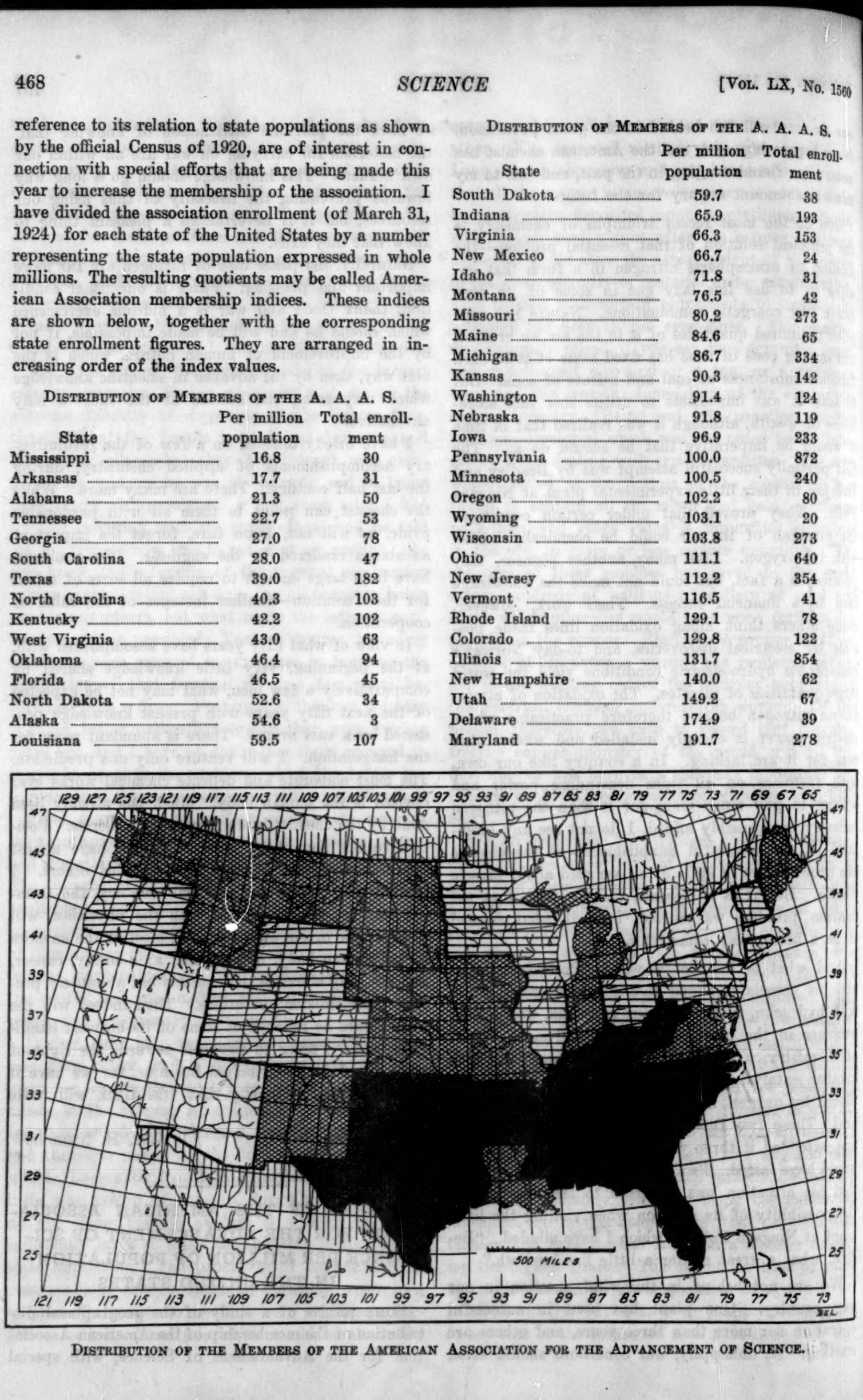
reference to its relation to state populations as shown by the official Census of 1920, are of interest in connection with special efforts that are being made this year to increase the membership of the association. I have divided the association enrollment (of March 31, 1924) for each state of the United States by a number representing the state population expressed in whole millions. The resulting quotients may be called American Association membership indices. These indices are shown below, together with the corresponding state enrollment figures. They are arranged in increasing order of the index values.

Distribution of Members of the A. A. A. S.

State	Per million population	Total enrollment
Mississippi	16.8	30
Arkansas	17.7	31
Alabama	21.3	50
Tennessee	22.7	53
Georgia	27.0	78
South Carolina	28.0	47
Texas	39.0	182
North Carolina	40.3	103
Kentucky	42.2	102
West Virginia	43.0	63
Oklahoma	46.4	94
Florida	46.5	45
North Dakota	52.6	34
Alaska	54.6	3
Louisiana	59.5	107

Distribution of Members of the A. A. A. S.

State	Per million population	Total enrollment
South Dakota	59.7	38
Indiana	65.9	193
Virginia	66.3	153
New Mexico	66.7	24
Idaho	71.8	31
Montana	76.5	42
Missouri	80.2	273
Maine	84.6	65
Michigan	86.7	334
Kansas	90.3	142
Washington	91.4	124
Nebraska	91.8	119
Iowa	96.9	233
Pennsylvania	100.0	872
Minnesota	100.5	240
Oregon	102.2	80
Wyoming	103.1	20
Wisconsin	103.8	273
Ohio	111.1	640
New Jersey	112.2	354
Vermont	116.5	41
Rhode Island	129.1	78
Colorado	129.8	122
Illinois	131.7	854
New Hampshire	140.0	62
Utah	149.2	67
Delaware	174.9	39
Maryland	191.7	278



Distribution of the Members of the American Association for the Advancement of Science.

DISTRIBUTION OF MEMBERS OF THE A. A. A. S.

State	Per million population	Total enrollment
Connecticut	192.6	266
New York	208.1	2,161
Massachusetts	218.3	841
Arizona	248.5	83
Nevada	259.7	20
California	268.2	919
District of Columbia	1,383.6	606

What characteristics of our membership and of the various state populations may be disclosed by this array of figures and what may be the geographic, historical and cultural reasons for their arrangement may be left to the reader's judgment. The accompanying chart of the United States is the result of plotting the index values in four groups or ranges—*high* (unshaded), *high-medium* (horizontal hatching), *low-medium* (double hatching) and *low* (black). The District of Columbia presents a special case (with its very great association enrollment and its small population) and its membership index should not be considered as at all coordinate with the others. It is consequently left out of account in the plotting.

High membership indices (over 200 members per million of population) occur for two separated areas: (1) the area of California, Nevada and Arizona, and (2) that of New York and Massachusetts. High-medium indices (100 to 200 members per million of population) are shown for Oregon, Wyoming, Utah, Colorado, Minnesota, Wisconsin, Illinois, Ohio, Pennsylvania, Maryland, Delaware, New Jersey, Connecticut, Rhode Island, Vermont and New Hampshire. Connecticut and Maryland are almost within the high range. Low-medium indices (between 50 and 100 members per million of population) represent Alaska, Washington, Idaho, Montana, North Dakota, South Dakota, Nebraska, Kansas, New Mexico, Iowa, Missouri, Louisiana, Michigan, Indiana, Virginia and Maine. Low indices (less than 50 members per million of population) are shown for Oklahoma, Texas, Arkansas, Kentucky, West Virginia, Tennessee, Mississippi, Alabama, North Carolina, South Carolina, Georgia and Florida. At the time these calculations were made the total enrollment of the association in the United States was 11,709, which gives an average association membership index of 110.7. The average is closely approximated by the index for Ohio (111.1).

With regard to the enrollment numbers themselves (the last column of the table), only three members reside in Alaska and only 20 in Wyoming and in Nevada. The largest enrollment (2,161) is for New York, which is followed by California (919), Pennsylvania (872) and Illinois (854).

Due partly to special invitation letters sent out from the permanent secretary's office and doubtless partly to the great success of recent meetings and the increasingly representative publicity given to the association by the daily press, the membership roll has been greatly increased during the last year. At the close of the fiscal year 1922–23 (September 30, 1923) the total association enrollment was 11,704. On September 30, 1924, it was 12,887. During the fiscal year just closed there have been 121 recorded deaths among the members and 670 members are shown to have resigned or have allowed their membership to lapse by non-payment of dues for two years.

The special arrangement in celebration of the passing of the seventy-fifth year since the founding of the association, an arrangement by which any member of an affiliated organization may join the American Association for the Advancement of Science without payment of the usual five-dollar entrance fee, will remain available until next January 1.

BURTON E. LIVINGSTON

SCIENTIFIC EVENTS

NEW COLLECTION OF PALEOLITHIC MATERIAL AT THE LOGAN MUSEUM OF BELOIT COLLEGE

THE Logan Museum of Beloit College has secured, through the efforts of Mr. Alonzo W. Pond, a large collection of Paleolithic and Neolithic materials from Europe. Some of the more important portions of the collection are as follows:

Thirty-six carvings on stone from Limeuil, France. These are of the Magdalenian period and were the first portable carvings on stone to be discovered in the Paleolithic stations of Europe. Later, search was made in the débris of La Madeleine and similar work discovered. The carvings from La Madeleine and those from Limeuil are all in the National Museum at Paris except this collection now in the Logan Museum. The carvings represent the typical animals of the Magdalenian period, such as the horse, reindeer, bison and the ur. This important collection was secured through the courtesy of Dr. Frank G. Logan, of Chicago, who financed the special purchasing expedition sent out by the Logan Museum during the past summer.

In addition to the carvings on stone, the expedition obtained the well-known Didon necklace. This necklace is Aurignacian in age, and is composed of bone, stone and ivory beads from the Abri Blanchard in France. There are 143 beads, including an ivory fish pendant and four other pendants of bone. Each piece is carved from a bone or ivory baton and many are shaped like tiny baskets. They range in size from less than three millimeters in length to two or three centimeters. Each one has a hole drilled through each side with a tiny drill. The collection

contains over half of all the beads of this type and period so far discovered.

The other material collected this summer for the Logan Museum illustrates every type of European prehistory from the Eolithic to the Bronze Age, and was gathered in England, France, Switzerland and Denmark. It includes eoliths from the Harrisonian collection of East Anglia, early paleoliths from Dr. Balfour, of Oxford, and Dr. Lewis Clark, of Cambridge, also Cromer flints from Messrs. Maynard and Reid Moyre, of Ipswich. From France, Mousterian material was obtained from La Quina through Dr. Henri-Martin, from Haute Roche through L. Didon, also from Le Moustier, Le Placard and Le Miquoc. The Aurignacian flints came from Laussel, George d' Enfer and La Blanchard.

The Solutrean collection came from Laugerie Haute and La Placard. Neolithic and bronze material was obtained through the National Museum at Zurich, Switzerland, also Neolithic objects from Denmark, obtained through collectors, but passed upon by Inspector Kjor of the National Museum at Copenhagen, Denmark.

Magdalenian artifacts from Limeuil, La Madeleine and Laugerie Basse were secured through the efforts of Abbe Bouyssonie. Some very interesting objects, including an urn from a dolmen burial, were obtained from Tebessa, Algeria, through the kind offices of M. Reygasse, a governor in the province of Constantine, Algeria.

All who are interested in this collection are cordially invited to inspect it and to study not only the materials on exhibition, but those duplicates which are placed in storage, but which will be made accessible, at any time, to those who wish to study them

George L. Collie,
Curator

Logan Museum

THE PAN-AMERICAN CONFERENCE ON STANDARDIZATION

The Peruvian government has invited the twenty-one republics in the Pan–American Union to a conference on standardization to be held at Lima, Peru, beginning on December 23 of this year. The conference is called by the Pan–American Union at the request of the Fifth International Conference of American States which met at Santiago, Chile, in 1923. The Peruvian government will act as host.

Sixty technical and trade organizations in this country have been invited to send representatives and there will be representatives of similar organizations from other countries.

The general purpose of this conference will be to study the possibilities of developing inter-American and international standards for raw and finished materials as well as standardized classifications and nomenclature and to make recommendations with regard to the steps to be taken by the states looking toward the development of these objectives.

The Peruvian government has sought the cooperation of the Pan–American Union and the Inter–American High Commission in the development of plans and agenda, and these departments in turn have sought the advice of representative organizations and individuals. The preparatory work in questions relating to agricultural products and raw materials are being handled by the U. S. Departments of Commerce and Agriculture. The American Engineering Standards Committee has assumed an important part in preparing for the work among the manufacturing industries of this country and at the request of Director General Rowe has organized an advisory committee.

No attempt will be made to adopt actual standards at this meeting, but it is hoped that a substantial basis for inter-American standardization can be laid, first, through the development and encouragement of standardization work in the various states and, second, through the designation of some organization which will act as a central agency for the development of inter-American standardization. It is expected that plans will be made for a second conference within a couple of years.

The Peruvian government has not yet published the final agenda. The advisory committee to Director General Rowe of the Pan–American Union is, however, engaged in getting papers together for the conference. These will deal not only with the broad principles of standardization both national and international, but with practical economic conditions and there will be a number of papers of a popular nature dealing with particularly notable achievements in the field of standardization. Since the field of raw materials is more nearly ready for immediate cultivation and is of special interest to many of the American states, emphasis at this first conference will be laid upon this side of the undertaking.

THE FOURTH ANNUAL MEETING OF THE HIGHWAY RESEARCH BOARD

The Highway Research Board will hold its fourth annual meeting on December 4 and 5 in the new building of the National Research Council, Washington, D. C.

Mr. Thomas H. MacDonald, chief of the Bureau of Public Roads, will present a paper on the "Financial value of highway research as applied to road construction."

The various committees of the board will make their reports which will include the following subjects: The economic theory of highway improvements, structural design of roads, character and use of road

material, highway traffic analysis, highway finance, highway maintenance and also a report of the special investigation on reinforcement in concrete roads.

Research apparatus that has been successfully used in various experiments will be on display. This exhibit will not only include the apparatus used in laboratories, but will include also various loadometers, traffic counters and other instruments in use on the road.

On the evening of December 4, Mr. Herbert Hoover, secretary of the Department of Commerce, will speak at the highway research dinner.

This is the one meeting of the year where there is a rounded discussion of the practical application of highway research. Highway executives and engineers will find this meeting to be one of intense interest because of the correlation of research and practise.

THE CARNOT CENTENARY

THE one hundredth anniversary of the announcement by the French physicist and engineer, Nicholas Leonard Sadi Carnot, of the principle of thermodynamics, later known as the second law of thermodynamics and the Carnot cycle, will be celebrated by American engineering, physical and chemical societies and educational institutions of New York, at a meeting to be held under the auspices of the Engineering Foundation, on December 4 at 8:15 p. m., in the auditorium of the Engineering Societies Building.

The program will be as follows:

Dr. Wm. F. Durand, president-elect, American Society of Mechanical Engineers, will preside.

Addresses, Illustrated by Lantern:

Dr. Michael I. Pupin, professor of electromechanics of Columbia University; fellow of the American Institute of Electrical Engineers; member, American Physical Society, National Academy of Sciences and the National Advisory Committee for Aeronautics, will speak on "Carnot's principle."

Dr. William LeRoy Emmet, consulting engineer of the General Electric Company; member, American Institute of Electrical Engineers, Society of Naval Architects and Marine Engineers, National Academy of Sciences and the Naval Consulting Board, will speak on the "Application of Carnot's principle in engineering."

Cooperating Institutions and Societies:

American Society of Civil Engineers.
American Institute of Mining and Metallurgical Engineers.
American Society of Mechanical Engineers.
American Institute of Electrical Engineers.
Engineering Foundation.
American Physical Society.
American Chemical Society.
Columbia University.
New York University.
Stevens Institute of Technology.
College of the City of New York.
Polytechnic Institute of Brooklyn.
Pratt Institute.
Cooper Union for the Advancement of Science and Art

Committee of Arrangement:

American Society of Civil Engineers, George H. Pegram.

American Institute of Mining and Metallurgical Engineers, W. L. Saunders.

American Society of Mechanical Engineers, Joseph W. Roe.

American Institute of Electrical Engineers, L. W. W. Morrow.

Columbia University, George B. Pegram, Walter I. Slichter, Walter Rautenstrauch.

SCIENTIFIC NOTES AND NEWS

DR. THOMAS HUNT MORGAN, professor of zoology at Columbia University, has been awarded the Darwin medal of the Royal Society of London, for his work in zoology, and especially for research in heredity.

DR. HIDEYO NOGUCHI, of the Rockefeller Institute for Medical Research, New York, was elected corresponding member of the Accademia Medico-Fisica Fiorentina at the centenary celebration of its founding in May, 1924. The French government has conferred on him the decoration of Chevalier de la Légion d'Honneur.

DR. ÉMILE ROUX and Dr. Louis Marten, of the Pasteur Institute; Professor Roger, dean of the faculty of medicine; Inspector-General H. Vincent, and Professors Achard, Carnot, Legueu and Widal, of Paris, have been elected honorary foreign members of the Academy of Medicine of Rome.

THE Alvarenga Prize of the College of Physicians of Philadelphia, for 1924, has been awarded to Dr. Gordon Cameron, Victoria, Australia. His subject was "Pancreatic anomalies; their morphology, pathology and clinical history."

A. V. VASSILIEV, formerly professor of mathematics at the Universities of Kazan and Petrograd, will celebrate in Moscow the fiftieth anniversary of his teaching activity on December 12.

PROFESSOR C. O. BATES, head of the department of chemistry at Coe College, is retiring under the Carnegie Foundation. He will continue his work as chemist for the city of Cedar Rapids, Iowa.

DR. E. J. LUND, associate professor of physiology in the University of Minnesota, has been named as an occupant of the American Association table at the Naples Zoological Station, for the period from December 10 to February 1 next.

DR. GEORGE E. BREWER has been nominated for the

presidency of the New York Academy of Medicine, in succession to Dr. George Stewart, whose term expires in December. Dr. Charles A. Elsberg and Dr. Frederick Van Buren were placed in nomination for vice-president.

DR. BENJAMIN T. BROOKS has been appointed chairman of a committee of the National Research Council to investigate the chemistry of petroleum.

PROFESSOR JAMES KENDALL, of the department of chemistry, Columbia University, has been reenrolled as a specialist in the United States Naval Reserve Force, with promotion to the rank of lieutenant-commander.

DR. J. V. HOFMAN, formerly director of the Wind River Forest Experiment Station, Washington, has accepted the position of assistant director of the Pennsylvania State Forest School at Montalto.

DR. A. T. LARSON and Dr. R. L. Dodge have left the Fixed Nitrogen Research Laboratory to take up work with the du Pont Company.

DR. W. A. ORTON has resigned as pathologist in charge of the office of cotton, truck and forage crop disease investigations in the U. S. Bureau of Plant Industry, to become scientific director and general manager of the Tropical Plant Research Foundation. Dr. Orton entered the service of the Department of Agriculture in 1899.

DR. H. FOSTER BAIN, director of the Bureau of Mines, will sail from the United States for Argentina on November 22 to make an extended study of the development of the steel and iron industry at the request of the Argentina government.

ON the occasion of the dedication of the Cornelia Clapp Laboratory at Mount Holyoke College, which took place in connection with the celebration of the eighty-seventh anniversary of the founding of the college, an address was given by Professor Edwin Grant Conklin on "Biology and human life." Dr. Clapp spoke of her fifty years teaching at the college and of the early days of the department of zoology of which she was the founder.

PROFESSOR CHARLES FABRY, director of the Institute of Optics, Paris, delivered an address on November 15, on "Thirty years work in spectroscopy with the interferometer" before a joint meeting of the Washington Academy of Sciences and the Philosophical Society of Washington.

DR. THORVALD MADSEN, director of the State Serum Institute of Denmark, will deliver the fourth Harvey Society lecture at the New York Academy of Medicine, on Saturday evening, November 22. His subject will be "Temperature and immuno-chemical reactions." The fifth Harvey Society lecture will be delivered by Dr. Willem Einthoven, professor of physiology in the Royal University of Leyden, Holland, on Saturday evening, December 6. His subject will be "The relationship of mechanical and electrical phenomena of muscular contraction with special reference to the cardiac muscle."

DR. OTTO WARBURG, of the Kaiser Wilhelm Institute of Biology, Berlin (Dahlen), has recently given two lectures before the scientific staff of the Rockefeller Institute for Medical Research, New York, "On the metabolism of carcinoma cells" and "Iron as an oxygen carrier of the respiration ferment." The lectures were followed by laboratory demonstrations of his methods of studying tissue respiration.

DR. HARRISON E. HOWE, editor of *Industrial and Engineering Chemistry,* gave a lecture at the Franklin Institute, on November 19, on "The trend and purpose of modern research."

THE seventh public lecture of a series on Physics in industry was on "Electrical precipitation," and was delivered by Sir Oliver Lodge on October 29, at the Institution of Electrical Engineers, London. The chair was taken by Sir Charles Parsons, president of the institute.

THE seventh public lecture of a series on physics was delivered on November 6, at the Finsbury Technical College, London, by Julian L. Baker, who spoke on "The chemist and the fermentation industries."

THE Thomas Hawksley lecture of the Institution of Mechanical Engineers, England, was delivered at the institution on November 7, by Vice-Admiral Sir George G. Goodwin. The subject was "The trend of development of marine propelling machinery."

THE Bradshaw Lecture of the Royal College of Surgeons of England on "Some clinical aspects of carcinoma of the breast" was delivered by Dr. Raymond Johnson on November 6, and the Thomas Vicary Lecture on "Sir Richard Owen as conservator" was given by Sir Arthur Keith, on November 12.

PROFESSOR H. B. DIXON, honorary professor of chemistry in the University of Manchester, delivered the inaugural lecture on "The life and work of Ludwig Mond" at the University of Manchester on October 20.

THE bronze bust of Dr. William H. Sanders, for many years professor in the department of medicine at the University of Alabama, has been given to the state of Alabama by the Alabama State Medical Association. It will be mounted at the entrance of the state health department building at Montgomery.

IN connection with the celebration of the centennial of the founding of the Medical College of South

Carolina, there was unveiled on November 12 a memorial tablet to Dr. Frank L. Parker, late professor of anatomy and dean of the medical college.

DR. THOMAS L. WATSON, Corcoran professor of geology at the University of Virginia and state geologist of Virginia, known for his contributions to mineralogy, petrology and economic geology, died on November 10 at the University of Virginia, aged fifty-three years.

NED HOLLISTER, superintendent of the National Zoological Park since 1916, a leading mammalogist, died on November 3, aged forty-eight years.

SIR ARCHIBALD GEIKIE, for many years director-general of the Geological Survey of the United Kingdom and former president of the Royal Society, the British Association for the Advancement of Science and the Geological Society of London, has died at the age of eighty-nine years.

DR. E. G. DEVILLE, director-general of surveys, Canada, died recently at the age of seventy-five years.

CHARLES FERGIE, ex-president of the Canadian Mining Institute, and a well-known mining engineer, died recently in his sixty-seventh year.

DR. J. E. CAMPBELL, F.R.S., lecturer in mathematics at the University of Oxford, has died, aged sixty-two years.

PROFESSOR DR. THEODOR KOCH-GRUNBERG, of the Ethnological Museum at Stuttgart, has died of malaria contracted while carrying on ethnological explorations in South America.

A DESIGN for a monument to Louis Pasteur has been submitted to the Pasteur memorial committee in Chicago by Leon Hermant, a French sculptor residing at the present time in Chicago. A sum of $100,000 is being raised with which to erect the memorial, and to endow a research scholarship that will be open to all American students. The monument design is a terraced fountain surmounted by a column which supports a bust of Pasteur. Clinging to the column are various supplicating human figures reaching up to receive healing from the great benefactor.

THE United States Civil Service Commission announces an examination for assistant scientist (apicultural physiologist), to fill a vacancy in the Bureau of Entomology, Department of Agriculture, Washington, D. C., at an entrance salary of $2,400. Receipt of applications closes on December 2. An examination is also announced for associate ordinance engineers with entrance salaries ranging from $3,000 to $3,600. Receipt of applications will close on December 16.

OFFICERS elected at the recent meeting of the Association of Official Agricultural Chemists were: Dr. C. A. Browne, chief of the Bureau of Chemistry, *president;* H. D. Haskins, Amherst, Mass., *vice-president;* Dr. W. W. Skinner, assistant chief of the Bureau of Chemistry, *secretary-treasurer.* The new members of the executive committee are Dr. W. W. Randall, of Baltimore, and Dr. W. H. MacIntire, of Knoxville. New members of the committee on recommendations of referees are H. A. Leppar, Dr. E. M. Bailey and Dr. A. G. McCall.

A SPECIAL joint meeting of the Helminthological Society of Washington and the Entomological Society of Washington was held on October 31, in the National Museum, Washington, D. C., in honor of Professor E. Brumpt, head of the laboratoire du parasitologie at the University of Paris. Dr. W. W. Cort, president of the Helminthological Society, acted as chairman, and Dr. C. W. Stiles, of the U. S. Public Health Service, introduced the guest of honor. Professor Brumpt outlined the organization of the laboratoire du parasitologie of the École de Médecine at Paris, which includes the following divisions: (a) mycology, (b) nematodes, (c) cestodes and trematodes, (d) protozoa, (e) insects, (f) culture of trypanosomes and other parasitic protozoa and (g) leeches, each section being assigned to a different worker. Professor Brumpt also touched upon investigations that are being conducted in his laboratory and emphasized especially the work on the transmission of trypanosomes of cold-blooded vertebrates by leeches, the rearing of ticks and other anthropod vectors of protozoan diseases, studies on strongyloides of various animals, and studies on anaplasmosis of cattle. Dr. L. O. Howard, chief of the Bureau of Entomology, made the closing remarks.

IT has been previously announced that the First International Congress of Mental Hygiene would be held in this country during the year 1925, if a fund adequate for the purpose could be secured by midsummer of 1924, since it would take a year at least to organize and arrange for the congress. Widespread interest in this project exists, but this interest has not yet expressed itself in the form of adequate financial support. In consequence, the holding of the congress must be postponed. The organizing committee in charge of the plan hopes to secure an adequate fund in time to hold the congress in 1926. Interest in the project continues to grow, as does the number of national leagues and committees for mental hygiene that will participate when the congress is held. Such societies have already been organized in Belgium, Brazil, Canada, Czecho-Slovakia, Denmark, France, Great Britain, Hungary, Italy, South Africa and the United States, and are in process of formation in Australia, China, Germany, Greece, Holland, Japan, Luxemburg, Norway, Sweden and Switzerland.

CLOUDY conditions at Arequipa, Peru, during the months of December and March, preventing satisfactory observations, have led to the establishment of a new branch of the Harvard Observatory at San José, Peru, halfway between Arequipa and the Port of Mollendo. Dr. J. S. Paraskevopoulos, who is in charge of the Boyden Station at Arequipa, opened the temporary station of the new branch at San José, on November 1. The site selected is 4,850 feet above sea level, and has been chosen because at this elevation there has been found to prevail a nearly cloudless belt of sky even when at the same time Arequipa at its 8,000 feet of altitude is cloud-bound and Mollendo at its proximity to sea level is covered with low-hung clouds. Thus San José, set in the broad pampa between, on the other hand, gives promise of yielding excellent and dependable observing conditions. Dr. Paraskevopoulos will set up two telescopes at San José, a one-inch and a three-inch, both photographic telescopes, to be used in the Harvard Sky Patrol, which was begun in a systematic manner over forty years ago.

A CONTRACT has been awarded by the General Electric Company, Schenectady, for a five-story annex to the research and general engineering laboratory, costing approximately $550,000. The new building will be of reinforced concrete with brick veneer and will provide 115,000 square feet of floor space.

THE *Journal of Medical Research*, official organ of the American Association of Pathologists and Bacteriologists, will change its name to the *American Journal of Pathology*, January, 1925. According to the *Journal* of the American Medical Association it has been given a subsidy of $7,500 a year for five years for the distinct purpose of helping pathology regain the prominence it formerly held as a fundamental branch of medicine, and to encourage young men of the best type to take up pathology as a career. The *American Journal of Pathology* will be published under the management of the present editorial board and will appear bimonthly. It will be restricted to pathology, especially the morphologic side.

COLUMBIA UNIVERSITY and the insular government of Porto Rico have established a school of tropical medicine at San Juan, Porto Rico, under the administration of Columbia University. According to the *Journal* of the American Medical Association the school was opened on September 25. Pending the reorganization of the Institute of Tropical Medicine and the erection of a laboratory building in San Juan, the courses in the fundamental biologic and chemical subjects will be given at Columbia University, New York. The courses in clinical medicine and surgery, preventive medicine, public health and sanitation, beginning on January 5, will be given in Porto Rico by members of the Institute of Tropical Medicine, the department of health, the Presbyterian Hospital of San Juan, and by members of the hookworm and malaria stations of the International Health Board. The courses will include laboratory work, clinical teaching and the demonstration of sanatorium machinery in action. Clinical material will be available at the Municipal Hospital of San Juan, which has set apart two wards for the exclusive use of the school; at the Presbyterian Hospital of San Juan, with a capacity of seventy-five beds and an active dispensary service of about 4,000 cases a month; and at the various special hospitals and dispensaries of the department of health which is actively cooperating in the project. The last month of the course will be given over to a medical expedition into the mountains of Porto Rico. The course is open to qualified graduates in medicine and will cover a period of eight months. The cost of living at San Juan will range from $100 to 150 a month. Registration will be limited to twenty students. Inquiries should be addressed to the dean of the Columbia University School of Medicine.

ACCORDING to *Nature*, a survey of the Great Barrier Reef area has been undertaken by the Commonwealth Government of Australia, and the naval sloop *Geranium* has been detailed for the work. The vessel will have a seaplane attached for general help and work in the survey, and a preliminary flight around the coastline of Australia was recently completed with the view of deciding the kind of assistance which can best be afforded from observations in the air. The commander of the *Geranium* is a member of the Barrier Reef Committee of the University of Queensland, and he will take with him two scientific investigators attached to the committee.

THE Fremont Forest Experiment Station, which was established by the United States Department of Agriculture at Colorado Springs, Colorado, is celebrating its fiftieth anniversary this year. The second of its kind in the western forest regions of the country, it has for a number of years been conducting experiments with trees similar to those made with agricultural crops and garden plants at agricultural experiment stations. The field depot of the station is on Mount Manitou. Besides these laboratory experiments, a considerable part of the work of the station is distributed over the national forests of Colorado, Wyoming, South Dakota and Nebraska, where field tests are made and permanent plots established to determine the best reforestation practices, the rate of

growth of stands, the best methods for thinning stands and for obtaining natural regeneration of forests. In some localities the relation of grazing to forest regeneration is receiving attention.

UNIVERSITY AND EDUCATIONAL NOTES

THE estate of the late J. Stephen Tripp, amounting to some $550,000, "to be used as the regents see fit," has come into the hands of the University of Wisconsin, as a result of the death of the last beneficiary.

FIRE at Earlham College has destroyed the administration building and part of the museum. The damage done is estimated to be $250,000, in addition to the loss of many scientific records.

THE Ramsay Laboratory of Chemical Engineering at University College, London, was opened on November 12.

PROFESSOR GUIDO H. MARX this year succeeds Professor William F. Durand, retired, as head of the department of mechanical engineering at Stanford University.

DR. WILLIAM PINKERTON OTT, associate professor of mathematics at Vanderbilt University, has been appointed head of the department of mathematics at the University of Alabama.

DR. P. M. GINNINGS has resigned as professor of chemistry at Centenary College of Louisiana, to become professor of chemistry at North Carolina College for Women. His place at Centenary College will be taken by Dr. Albert Salathe, professor of chemistry at Sweet Briar College, Virginia.

DR. CARL ARTHUR HEDBLOM, of the Mayo Clinic, Rochester, Minn., has been appointed chief surgeon of the Wisconsin General Hospital, and professor of surgery at the University of Wisconsin Medical School, Madison.

L. P. MCCANN has been appointed associate professor of animal husbandry at Colorado Agricultural College to succeed Professor B. W. Fairbanks.

DR. EARL D. MACPHEE, of the University of Alberta, has accepted an appointment in the department of psychology at the University of Toronto.

PROFESSOR LUCATELLO, of Padua, has been nominated successor of Professor Maragliano in the chair of internal medicine at Genoa.

PROFESSOR ANDREW ROBERTSON, professor of mechanical engineering in Bristol University, has been appointed principal of Bristol Merchant Venturers Technical College, in succession to the late Dr. Wertheimer.

DISCUSSION AND CORRESPONDENCE

THE QUANTUM NUMBERS OF THE BOHR ORBITS IN THE ALKALI ATOMS

IN a recent article, Dr. L. A. Turner[1] proposes a change in the assignment of quantum numbers to the orbits in certain atoms, as given by Bohr in his latest theory.[2] This applies particularly in the principal quantum numbers assigned to the outermost orbits in the heavier alkali atoms and alkaline earth ions. The essential features of the proposed change may be indicated briefly in the following table:

Element	N	n^*	n_B	n_T	q_B	q_T
Li	3	1.59	2	2	.41	.41
Na	11	1.63	3	3	1.37	1.37
K	19	1.77	4	4	2.23	2.23
Rb	37	1.81	5	6	3.19	4.19
Cs	55	1.87	6	8	4.13	6.13

In the above table, N denotes the atomic number, n^* the effective quantum number of the outermost orbit in the atom, n_B the corresponding principal quantum number as assigned by Bohr, n_T, the same as assigned by Turner, while q_B and q_T are the corresponding quantum defects (differences between n^* and n) on the two points of view, respectively. It will be seen that Turner proposes to increase Bohr's principal quantum numbers for the orbits in Rb and Cs by *one* and *two*, respectively. His reason for this step is based on an examination of the variation of the quantum defect with N. For he finds that if we plot q as a function of N, using the Bohr values, we get a broken line with the break occurring at K (as will be seen from an inspection of the table), while if we plot q as a function of N, using Turner's values, we get a very nearly straight line. (It must here be remarked that this also applies to the corresponding case in the ionized alkaline earths and certain other atoms). No theoretical reason can apparently be assigned to the straightness of this line. The present writer wishes to examine available evidence as to the justification of Turner's new assignment.

Numerical calculations have been carried out by the writer[3] for the dimensions of the orbits in the Bohr models of the alkali atoms. These show conclusively that Bohr's assignment of the quantum numbers for the outermost orbits is the only one which yields the correct values of the effective quantum numbers, provided, of course, that the *inner* groups of orbits remain as assigned in the Bohr theory. In fact, a short calculation on the basis of the results there obtained indicates that the assumption of $n = 6$ in-

[1] L. A. Turner, *Phil. Mag.*, Sept., 1924.

[2] See particularly N. Bohr, *Ann. d. Phys.*, 71, 228, 1923.

[3] Proc. Amer. Phys. Soc. 23, 552 (A8) 1924. For complete details of calculations see *Jour. of Math. and Phys.*, Mass. Inst. Tech. III, 191, 1924 (May).

stead of $n = 5$ in the case of Rb will lead to a value of $n^* = 2.80$, approximately, while the choice of $n = 8$ for Cs will yield $n^* = 3.80$, approximately.

It thus appears that Turner's assignment, if true, will necessitate a complete rearrangement of the inner quantum groups—a very serious step and one open to much criticism in the opinion of the present writer. One significant point may be mentioned here. The writer found in the calculations above mentioned that the computed values of the dimensions of the outermost orbits in the ionized alkali atoms (a measure of the ionic radii) obey the Grimm inequality law,[4] *viz.*,

$$R_K - R_{NS} > R_{Cs} - R_{Rb} > R_{Rb} - R_K$$

where R_{Na}, R_K, etc., refer to the radii of the ions of sodium, potassium, etc. This law appears to be an extremely fundamental one in connection with atomic characteristics in general. (It is interesting to note that it is followed, as might be expected, by the effective quantum numbers themselves). A rearrangement of the inner groups of orbits in Rb and Cs would vitiate this result, and lead to values for the dimensions of these ions which are much too large in comparison with the dimensions of the lighter alkalies.

In the opinion of the writer it is therefore apparent that Turner's assumption, while leading to an interesting result, can hardly be maintained.

A thorough study of the quantum defect may be expected to be of great value in the development of the Bohr theory, particularly in connection with the analysis of the spectral terms of multiply-ionized atoms. Certain simple relations relevant hereto and admitting of simple interpretation on the Bohr theory are in process of derivation and arrangement by the writer and will be published shortly.

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WHITE INDIANS OF DARIEN

LIONEL WAFER, a ship's doctor and an associate of Dampier's, has left us an interesting account of the White Indians of the Isthmus of Darien. Wafer fell into the hands of the Darien Indians on the 5th of May, 1681. These were copper-colored natives of the coast, but while a captive among them he had frequent opportunities to observe other Indians of a different complexion. He has this to say about the White Indians:[1]

There is one Complexion so singular, among a sort of People of this Country, that I never saw nor heard of any like them in any part of the World. The Account will seem strange, but any Privateers who have gone over the Isthmus must have seen them, and can attest the main of what I am going to relate; tho' few have had the opportunity of so particular an Information about these People as I have had.

They are White, and there are of them of both Sexes; yet there are but few of them in comparison of the Copper-colour'd, possibly but one to two or three hundred. They differ from the other Indians chiefly in respect of Colour, tho' not in that only. Their Skins are not of such a White as those of fair People among Europeans, with some tincture of a Blush or Sanguine Complexion; neither yet is their Complexion like that of our paler People, but 'tis rather a Milk-white, lighter than the Colour of any Europeans, and much like that of a White Horse.

For there is this further remarkable in them, that their Bodies are beset all over, more or less, with a fine short Milk-white Down, which adds to the whiteness of their Skins: For they are not so thick set with this Down, especially on the Cheeks and Forehead, but that the Skin appears distinct from it. The Men would Probably have white Bristles for Beards, did they not prevent them by their Custom of plucking the young Beard up by the Roots continually: But for the Down all over their Bodies, they never try to get rid of it. Their Eye-brows are Milk-white also, and so is the Hair of their Heads, and very fine withal, about the length of six or eight Inches, and inclining to a Curl.

They are not so big as the other Indians; and what is yet more strange, their Eye-lids bend and open in an oblong Figure, pointing downward at the Corners, and forming an Arch or Figure of a Crescent with the Points downwards. From hence, and from their seeing so clear as they do in a Moon-shiny night, we us'd to call them Moon-ey'd. For they see not very well in the Sun, poring in the clearest Day; their Eyes being but weak, and running with Water if the Sun shine towards them; so that in the Day-time they care not to go abroad, unless it be a cloudy dark Day. Besides they are but a weak People in comparison of the other, and not very fit for Hunting or other laborious Exercise, nor do they delight in any such. But notwithstanding their being thus sluggish and dull and restive in the Day-time, yet when Moon-shiny nights come, they are all Life and Activity, running abroad, and into the Woods, skipping about like Wild-Bucks; and running as fast by Moon-light, even in the Gloom and Shade of the Woods, as the other Indians by Day, being as nimble as they, tho' not so strong and lusty.

The Copper-colour'd Indians seem not to respect these so much as those of their own Complexion, looking on them as somewhat monstrous. They are not a distinct Race by themselves, but now and then one is bred of a Copper-coloured Father and Mother; and I have seen a Child of less than a Year old of this sort. Some would

[4] H. Grimm, *Zs. f. Phys. Chem.*, 5, 353, 1921.

[1] "A New Voyage and Description of the Isthmus of America," by Lionel Wafer (Reprinted from the original edition of 1699) Cleveland, The Burrows Brothers Company, 1903.

be apt to suspect they might be the Off-spring of some European Father: But besides that the Europeans come little here, and have little Commerce with the Indian-women when they do come, these white People are as different from the Europeans in some respects, as from the Copper-colour'd Indians in others. And besides, where an European lies with an Indian-woman, the Child is always a Mostesa, or Tawney, as is well known to all who have been in the West-Indies; where there are Mostesa's, Mulatto's Etc. of several Gradations between the White, and the Black or Copper-colour'd, according as the Parents are; even to Decompounds, as a Mulatto-Fina, the Child of a Mulatto-man, and Mostesa-woman, Etc.

But neither is the Child of a Man and Woman of these white Indians, white like the Parents, but Copper-colour'd as their Parents were. For so Lacenta (an Indian chief) told me, and gave me this as his Conjecture how these came to be White, That 'twas through the force of the Mother's Imagination, looking on the Moon at the time of Conception; but this I leave others to judge of. He told me withal, that they were but short-liv'd.

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AGE OF SHAD ESTIMATED FROM EXAMINATION OF SCALES

AN estimation of the age of fish by counting the number of annular rings on the scales has been possible in the case of numerous species. For the shad (*Alosa sapidissima,* Wilson), however, this appears not to have been done up to the present time; although considerable success has been attained in age estimation of certain *Clupeidae* other than shad, for example, the herring.

The investigation, authorized by the Connecticut State Legislature and undertaken by the Board of Fisheries and Game for the purpose of discovering the cause and cure of the decline of Connecticut River shad, necessitated an extension of the meager existing knowledge of shad migrations. Age determinations were required for this phase of the work.

The annular rings (annuli) of the shad scale are rather difficult to see and to differentiate from other circular markings on the scale. I have therefore undertaken a systematic study of the scales from shad of various sizes, studying all the scale markings. Preliminary experience with staining and other methods of preparation to bring out the annular markings gave unsatisfactory results. It therefore appeared necessary to make use of other markings. Of these, the transverse grooves running completely across the scale were found to have a constant relation to the annuli in those scales in which the latter were sufficiently distinct to be counted. The relation is: two *complete* grooves (omitting incomplete ones) to one annulus. In young shad of known age, less than one year, there are one or two complete transverse grooves on the scale. Although annuli should be counted when possible, the counting of the grooves gives supplementary information and may even be relied upon when the annuli are not distinguishable. The number of the complete grooves divided by two gives the age of the shad in years.

Age determinations by this method have been confirmed by examination of the otoliths of shad. Mr. R. L. Barney, who has made these examinations, finds that the size and markings of the otoliths give age estimations which agree with the scale readings.

The scales selected for observation should be of regular shape and should show no distortion of scale markings such as apparently result from the effects of external injuries. I have used scales from the anterior part of the body at a point about half way between lateral line and pectoral fin.

Examination of shad ascending the Connecticut River during the present season shows that males are of ages four, five, six, seven and eight years, females, seven, eight, nine and ten years. Adult shad of both sexes of sizes less than 32 cm in length occur, as a rule, only in the sea.

This report is preliminary. A more extended account with drawings and microphotographs of the scales and with tabulated data will be published later.

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THE FRESH-WATER JELLYFISH (CRASPEDACUSTA SOWERBYI) IN KENTUCKY AGAIN

THIS fresh-water medusa, for many years regarded as a rarity by zoologists, appears to have become permanently established in Kentucky. In 1916 and 1917[1] it was found by the writer in great numbers in Benson Creek, but in subsequent seasons (of 1918 to 1923, inclusive) it was not found and thus seemed to have remained true to its history of infrequent appearances at widely separated points on the globe. But a visit made September 5, 1924, to the spot where it was discovered in 1916 showed it to be still there. Many were collected; hundreds could have been obtained. On the twelfth of this month a second visit to the locality showed it less common at the surface of the water, but in several hours spent in the search it was learned that it had retreated to a depth of several feet and could be brought up in some numbers by stirring the water with the oars of a rowboat. Its movements are stimulated by sunlight, and as the day was cloudy but few were attracted toward the

[1] SCIENCE, Vol. XLIV, 1916, p. 858; Vol. LVI, n. s., 1922, p. 664.

surface and within reach of my dip-net, though a good many were brought up by use of the oars. This habit of retreating from the surface when weather conditions are unfavorable explains the apparent absence of the medusae on some of my previous visits to the creek. It has become evident that cloudy weather is unfavorable to finding it. The best conditions, judging by the character of the three seasons when it has now been found, are settled, clear days, when the water is low, free from silt and there is little current in the creek.

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THE PEANUT PLANT

Since the peanut plant (*Arachis hypogea* L.) has become of such economic importance as to demand a description in every text-book on field crops, attention should be called to a mistake that was made by the early writers so that in the future the blossoms of this important plant might be correctly described.

Arachis hypogea is one of the Leguminosae and has sessile papilionaceous blossoms. The calyx consists of a tube about an inch in length crowned by the five sepal tips. On the throat of calyx tube are situated the five bright yellow petals. The calyx tube was mistaken for a peduncle and so described by the early authors, and the whole structure was termed a "sterile" blossom. After the blossom withers and falls off, the ovary, by the rapid growth of the internode between it and the receptacle, is lifted from between the bracteoles in the leaf axil and responding to geotropic influence turns toward the earth and the seeds are further developed and ripened only after it has been pushed below the surface of the ground. The early writers looked upon and described this gynophore with its ovary as a "cleistogamous" blossom.

Poiteau in 1805 first correctly described the blossom of the peanut. Robert Brown in 1816 confirmed Poiteau's description. In 1839 Bentham wrote of *Arachis hypogea* as a plant with dimorphic flowers, one with calyx and corolla which is always sterile, the fertile flowers having "neither calyx, corolla nor stamens . . ." and when Neisler in 1865 reconfirmed Poiteau's description, Bentham in the same year defended his paper of 1839. Corbett as a contributor to the "Cyclopedia of American Agriculture" (1907) describes the plant as having dimorphic flowers and *illustrates* the "fertile" and "sterile" blossoms.

Notwithstanding the works of Poiteau, Brown and Neisler, the majority of our modern publications, including scientific papers, agricultural bulletins and text-books on farm crops, in referring to the peanut plant seem to quote from the earlier writers and speak of it as having fertile and sterile blossoms, whereas it has complete blossoms and is self-fertilized.

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SCIENTIFIC BOOKS

Neurological Foundations of Animal Behavior. By C. J. Herrick, H. Holt & Co., New York, January, 1924, xii + 324 pp.

Physiological Foundations of Behavior. By C. M. Child, H. Holt & Co., New York, January, 1924, xii + 330 pp.

The "Neurological Foundations of Behavior," by C. J. Herrick, and the "Physiological Foundations of Behavior," by C. M. Child, were written in close collaboration and were issued from the press at the same time. They represent, so to speak, twin volumes; they appear, as twins commonly do, in the same garb, and they are of nearly the same size. But in addition to these superficial features of likeness, there are many other points of resemblance due to common hereditary factors. The writers appear to be in essential agreement in regard to their fundamental concepts. The notion of metabolic gradients which Child has elaborated in several volumes and a multitude of papers is adopted also by Herrick, and it forms the keynote of both volumes. The gradient idea, according to the authors, gives not only an interpretation of organic form, but it affords the basis for a science of behavior.

Both authors regard form and behavior as intimately and essentially correlated. It is the structure and physiological properties of the nervous system that form the neurological foundations of behavior, and Herrick's volume is devoted largely to describing the various types of nervous organization in different groups of animals, and in showing the significance of these types in relation to the kinds of behavior which the animals exhibit. After Herrick's first two chapters, which are mainly introductory, there is a description, in chapters 3 and 4, of the different types of receptors. Then follows in chapters 5 to 16 a survey of the types of nervous systems with their correlated kinds of activity from the protozoa to the higher vertebrates. For the reader who wishes to obtain a comprehensive idea of the architecture and evolution of the nervous system, these chapters will prove most useful. Throughout the volume, structure is interpreted from the standpoint of function. To show how the mechanism works is the constant aim.

For many readers, perhaps the most interesting of the series of chapters mentioned are those dealing with the "Evolution of the forebrain and functional factors in forebrain development." The forebrain is

the seat of intelligence in vertebrate animals, and a peculiar interest attaches to the study of its evolution. "Within the forebrain of higher vertebrates, and especially the cerebral cortex," says Herrick, "there are correlation and association centers of very different type, centers which are not dominated by any single sensorimotor system but are reached by fiber tracts from several lower sensory centers. Here the more difficult problems of conduct are solved; these are deliberative reactions, the occasion for which arises only when the innate instinctive and reflex modes of response prove inadequate to make the required adjustment."

How is this higher type of correlation brought about? What is the structural mechanism that underlies it? What is the basis of the modifiability of behavior, and especially how is behavior coordinated so as to secure the welfare of the organism? These are some of the questions which Herrick discusses in the following chapters. With Herrick, as with Child, the conception of dominance plays an important part in the interpretation of coordinated behavior. The nervous system is a dominating system, and the higher centers, at least for certain kinds of activity, dominate the lower ones.

> The higher brain centers, including the cerebral cortex of man and many of the subcortical correlation centers, do not replace the lower reflex centers, but on the other hand the only way into these higher centers is through the lower [see Herrick, 1913, and 1922, chap. 21]. Physiologically, this implies that the lower reflexes and instinctive reactions, which employ the direct passageways through the central nervous system, will always do the work when their stereotyped mechanisms are adequate to resolve any given stimulus complex into the appropriate and satisfying reaction. These lower centers are always first activated, but if they fail to solve the problem of conduct satisfactorily the flow of nervous energy will be dammed up in them and finding no appropriate outlet directly into the motor organs it will then be diverted upward into the higher correlation centers. Once these higher centers are activated, their own intrinsic processes liberate a large amount of latent metabolic energy of the very special type already described, resulting in a local summation or intensification of the excitation process.

When difficult problems have to be dealt with the lower centers pass the problem up to the higher ones, activating the latter with an intensified energy and making them thereby "the organs of highest physiological dominance of the entire body."

In the last chapter on "Progressive factors in evolution," Professor Herrick, who exhibits throughout the volume a keen appreciation of the broader aspects of his theme, permits himself the luxury of philosophizing a bit on a number of topics which lie near the borderland of neurology. Among these topics is a discussion of critical stages in progressive evolution, the uniformity and essential similarity of vital processes from Amœba to man, habit formation in education, creative intelligence, behavior in relation to consciousness, and finally the future of human evolution. On these as well as on many other suggestive discussions, limits of space forbid further comment.

The volume of Dr. Child consists of an elaboration of the gradient concept with especial reference to behavior. In all organisms there are, according to Child, gradations in the intensity of metabolic processes which determine the fundamental outlines of axial symmetry and structural differentiation. The existence of these gradients has been demonstrated in a great variety of organisms and by several different methods. Gradations of metabolic rate are indicated by differences in the rapidity of oxidation and the elimination of carbon-dioxide, differential susceptibility to poisons, and changes in electrical potential. Centers of high metabolism tend to dominate or control centers of low metabolism, excitation being conducted from the one to the other and thus forming the mechanism of the control which is exercised by the dominant center. In the regeneration of a hydroid from a piece of the stem the oral end of the piece usually exhibits the highest metabolism and therefore develops into the head. The head dominates and determines the way in which the part lying just below it develops, and the latter dominates the next region, etc., until the stem is shaped into a new hydroid with duly subordinated parts.

There is no doubt that these metabolic gradients exist. They are shown by the stems of hydroids, the bodies of planarian and annelid worms, the long axis of vertebrate embryos and the growing stems of plants. In one way or another, they probably occur in all organisms. According to Child, they constitute if not the chief, at least fundamentally important directive agencies in development and regeneration. There can be no doubt that they commonly accompany differentiation. Are they to be regarded as the cause of differentiation or its effect, or are both perhaps the result of some common underlying cause? Child believes that these gradients are actual causes of differentiation. In support of his view he cites many cases in which gradients may be reversed or new gradients established by environmental agencies which change the rates of metabolism in different parts of the organism. Even the major axes of plants and animals may be determined by external factors if the latter begin to operate sufficiently early.

Child has little sympathy with preformational theories of development. The production and main-

tenance of organic form is a dynamic process. Development is not a process of building in which materials first get arranged somehow and begin to function afterward. It is a process of physiological functioning, or we may say behavior, at all stages. The progress of experimental morphology has given the death blow to the older theories of both nuclear and cytoplasmic organization as a basis for development. Often there is, it is true, a visible organization of the substances of the egg, but it is also true that it has no very fundamental significance for ontogeny. It is the product of development and not its antecedent. Child is probably right in his contention that the theory of formative stuffs, which Loeb has taken over from Sachs, has little real explanatory value. He is probably also right in rejecting the various theories which would explain form production as akin to crystallization. Development he regards as a process of physiological regulation in which the differentiation of organic form is the outcome of organic adjustment. The thing that makes for order, in his view, is the relation of dominance and subordination involved in the establishment of gradients.

It has always been a troublesome problem for the epigenesist to supply a real explanation of the order and harmony manifested during development, and it is a noteworthy circumstance that the great protagonist of this doctrine, C. F. Wolff, felt himself compelled to postulate a *vis essentialis* as a guiding principle to keep things in order. Gradients are supposed to function as unifying agencies which introduce a certain system of correlation on account of the relations of dominance and subordination which they involve. Hence they form an alluring notion to an epigenesist who is seeking for a dynamic interpretation of the orderly wholeness of the organism in the various stages of its history.

Apparently a gradient is a very simple thing, at least at first. It is merely a decreasing series of metabolic changes which differ primarily in purely quantitative aspects. But quantitative changes, as Child plausibly argues, may cause qualitative differences, and the latter may in turn occasion further differentiations, the precise way in which the process of complication is carried out being conditioned by the initial constitution of the protoplasm which is transmitted by heredity. A simple gradient may be passed on through the polarity of the egg, but this axis is not important. It may be determined by environment. But once the gradient is set up, it does not matter much where or how, the rest of development follows.

We must refer the reader to the original volume if he would gain an idea of Child's application of the gradient concept to the problems of physiological integration, regeneration, budding, the functioning of the nervous system and the coordination of behavior. The notion of gradients has been the dominating concept in most of Child's numerous researches for several years. How far it will take us towards a causal explanation of the phenomena of organic regulation remains to be seen. The dominance and subordination brought about by pace-making centers is essentially a one-sided relation. It represents an autocratic type of control. It is analogous to the control of an army in which the general issues orders to the superior officers who transmit them to officers of lower rank, from whom they finally come down to the common soldiers. Is this the kind of government that goes on in an organism, or are the relations throughout those of a thoroughgoing reciprocality? Is the organism governed from a dominant center like a monarchy, or like a democracy with plenty of initiative and referendum? These are important questions in regard to Child's general viewpoint. If development and regeneration involve a thoroughgoing mutual adjustment of developing parts, the establishment of gradients can apparently do little more than provide for the localization of formative processes (to use a favorite expression of Driesch) without supplying the fundamental principle underlying the production of organic form.

In the last two chapters Child extends the gradient concept to the organization of society. "Leadership, dominance, the pacemaker play the same rôle in social as in physiological intergration." The center of high metabolism has its analogue in the social leader, or it may be in the "dominance of ideas." The similarities which exist between society and the organism largely grow out of the fundamental likenesses of their component units. And societies are essentially democratic whatever may be their form of political government. Even in the most arbitrary of despotisms rulers do not rule their subjects nearly so much as the subjects rule their rulers. Societies are everywhere founded on a give and take relationship; they are always mutual benefit organizations. If the analogy betwen social and physiological integration is to be taken seriously, as I believe it must, it would lead us to infer that the unity of the physiological organism is the result not so much of a one-sided relation of dominance and control as a thorough, mutual determination. I can not feel that Child's incursion into social science has strengthened his case. Rather, it has served to reveal more clearly a fundamental shortcoming of his theory of organic wholeness. It is not denied that the gradient relation may be one of fundamental importance in the establishment of organic axes and the localization of morphogenetic processes. But the gradient theory

suffers from much the same kind of inadequacy as the theory that social organization is the result of a hierarchy of dominant functionaries who derive their authority from a common ruler. It really matters little whether the dominant influences are conceived to be persons or ideas.

There are many features of Child's and Herrick's volumes which can not be considered in a brief review. Both books are substantial contributions from workers who have spent years of research and reflection in the fields which are covered. The biologist, whatever may be his specialty, may gain from them many new facts and stimulating ideas.

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SPECIAL ARTICLES

ENZYMES OF THERMAL ALGAE

THE algae of the hot springs in Yellowstone National Park offer good opportunity for a study of the distribution of enzymes in relation to the temperatures at which the organisms live. There is a complete series of thermal springs ranging in temperature from the boiling point (about 91° C) down to ordinary temperatures. Algae are found growing at a great many different temperatures within this range. One species of Phormidium was found growing at 89° C in Beryl Spring.

The action of some enzymes has been shown to be destroyed at temperatures much below the normal temperature range of some of these thermal algae. It seems of interest to determine at what range of temperature the thermolabile enzymes are present in the algae, and how the algae are able to conduct their metabolic processes at temperatures above the maximum for the activity of several important enzymes.

Phormidium laminosum was found growing in pure culture in Hymen Terrace spring at 73° C. to 65° C. Its range did not extend below 65° C. Possibly other factors than the temperature were concerned in this distribution, since the carbon dioxide and hydrogen sulfide used by this organism are quickly liberated from the water after it escapes. Possibly the temperatures below this range do not allow metabolic processes to proceed normally in the absence of certain enzymes.

Determinations on the catalase, oxidase, oxydo-reductase and peroxidase action of this Phormidium were made immediately at the spring. For oxydo-reductase activity the reduction of methylene blue in the presence of acetone was used. Strong reduction was shown by the preparation, some of which was probably due to the reducing substances present in the water which can not be eliminated. For oxidase activity, the oxidation of tetra methyl para phenylene diamine showed a slight activity. On the addition of hydrogen peroxide to this reagent a very active peroxidase action was shown. Catalase was determined by means of the Van Slyke apparatus commonly used for the determination of amino acids, the oxygen being liberated in the reaction vessel and measured in the burette. The material was collected from pure culture and the determinations were completed within a few minutes. No catalase activity was shown by the Phormidium filaments either suspended in water or after grinding for a long time in a mortar with fine quartz sand and calcium carbonate. The failure to decompose hydrogen peroxide was not due to any defect in the experiment or to poisonous substances in the spring water, since leaves of Iva xanthifolia treated in exactly the same manner with spring water showed high catalase activity at room temperature. It must be concluded, then, that this Phormidium possesses no catalase and little oxidase activity but shows a strong peroxidase and probably oxydo-reductase action.

Catalase previously has been found to be of universal distribution in living organisms. Czapek in his "Biochemie der Pflanzen" gives a bibliography of its distribution in various groups of plants and animals. Oscar Loew concluded that catalase was universally distributed, occurring in every organism and necessary in every living cell. This is the first instance of its absence from an organism having been demonstrated. G. B. Reed reported catalase activity in ripe and half ripe pineapples but found no activity in very green pineapples. No mention was made of controlling the acidity, so it seems probable that the catalase present in the green fruits was destroyed in the preparation. This enzyme, therefore, can not be required for the life activities of all organisms as has been suggested. The maximum temperature for the activity of catalase is low. Catalase derived from leaves of Iva xanthifolia was destroyed at the temperature of the spring water of Hymen Terrace (73° C.) by exposure for less than one minute. Oxydo-reductase is known to have a rather high optimum (57° C.) for its activity, and peroxidase activity is shown at the boiling temperature since it is thermostable, in fact, to such a degree that there is doubt that it should be included in the class of enzymes.

The fact that an organism can live at the temperature at which water boils at high altitudes demands that by some means it shall be able to carry on the hydrolytic cleavages or other chemical activities required for its metabolism. As the altitude increases there would be found a level at which water would maintain a constant temperature by boiling at a tem-

perature at which some members of the genus Phormidium live normally. This altitude would not be much higher than the present plateau of Yellowstone Park. The fact that amino acids and a great many substances found in living organisms can be synthesized without the intervention of organisms by the ultra-violet radiations existing at such altitudes is suggestive of the probable place of origin of life forms. If such complex substances should be formed under present conditions, they would be quickly used by the omnipresent organisms capable of using them. Before the appearance of any living organism there would be possible the accumulation of such substances in quantity, a condition which is not realized under existing conditions. The action of hydrolytic enzymes in thermal algae might be substituted by the purely physical condition of high temperature on account of the increase in the rate of chemical reactions with increase in temperature according to the Van't Hoff coefficient. If high temperature can substitute the action of hydrolytic or other enzymes in these thermal algae, this may give a clue regarding the environmental conditions obtaining at the time of the origin of living things, since at high temperatures no such enzymes might be required. It is difficult to conceive of an organism originating with a full complement of enzymes, photosynthetic pigments, etc. Absence of certain important enzymes from an organism may well indicate a primitive type of physiological processes in which the organism makes use of physical conditions of the environment to substitute the action of complex biological catalysts. Since these thermal algae are able to carry on their life processes without catalase, which is found in all other organisms, and since they possess certain thermostable catalysts, with the additional use of high temperature to speed up other chemical reactions which are commonly catalyzed in other organisms by special enzymes, they seem particularly adapted to growth at high temperatures. Certain of the enzymes may have become necessary only in the evolution of forms adapted to lower temperature. The chemosynthetic forms of the iron and sulfur bacteria have been considered for several reasons to closely approach the type of physiological processes demanded for a primitive organism. They are able to fix atmospheric nitrogen, and they synthesize their carbon compounds without the intervention of photocatalytic pigments using the oxidation of inorganic material such as H_2S as the source of energy for synthesis.

The algae of these springs offer opportunity for the solution of some physiological questions of fundamental importance. Owing to the lack of facilities for laboratory work in Yellowstone Park at the time, determinations of other enzymes was delayed until they might be made upon material preserved with toluol and with 85 per cent. ethyl alcohol. Report upon the occurrence of other enzymes in these algae will be made by Miss Olga Lakela, who has completed the work.

R. B. HARVEY

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THE PRODUCTION OF HYDROGEN SULFIDE BY YEAST

THE production of hydrogen sulfide by living yeast cells in the presence of sulfur or certain sulfur derivatives is well known in the literature. The work of de Rey-Pailhade[1] showed that yeast extracts were also able to produce hydrogen sulfide in the presence of sulfur. He attributed the formation of hydrogen sulfide to the presence of a substance in the yeast which he termed "philothion." The recent work of Hopkins,[2] however, appears to indicate that de Rey-Pailhade's "philothion" is similar to a dipeptide of glutamic acid and cystein which Hopkins isolated from yeast and animal cells. This compound after oxidation is easily reduced and also forms hydrogen sulfide when shaken with sulfur.

The presence of an active reducing enzyme in yeast has been demonstrated by Hahn[3] and others, so that very probably the reducing properties of yeast are largely due to enzyme activity of this nature.

The production of hydrogen sulfide by yeast, apart from its purely biochemical interest, is of considerable practical importance. Examples of hydrogen sulfide production are well known in the fermentation industries. Wine and beer stored in casks which have been fumigated with sulfur will often develop hydrogen sulfide, and such effects have been explained by the reducing activity of yeast in the presence of free sulfur, sulfites, and loosely bound sulfur compounds of a protein nature.

In flour and baking, however, the production of hydrogen sulfide by yeast in dough seems to have received little or no attention, and the writer has been unable to find any information or reference to this phenomenon in the literature thus far examined.

Recently the production of hydrogen sulfide by yeast in this connection was brought to the writer's attention. The flour was a northern spring patent, of normal appearance, odor and taste. It was capable of producing a fairly good bread, but on fermentation gave off the odor of hydrogen sulfide. An

[1] Rey-Pailhade, J. de *Compt. rend.*, *106*, 1683, *107*, 43, 1888, and subsequently.

[2] Hopkins, F. G., *Bio-chem. J.*, *15*, 286–315, 1921.

[3] Hahn, M., Münchener med. Wochenschrift, S. 595, 1902.

examination of the flour by the writer showed that when it was mixed in a dough with water and the usual amounts of the ingredients of a dough batch, hydrogen sulfide was evolved in quantities sufficient to discolor lead acetate paper immediately, followed by complete blackening, in less than a minute. Doughs made with 50 grams of flour, sufficient water and 1 gram of compressed baker's yeast also evolved hydrogen sulfide.

A dough was made of the flour with water containing hydrochloric acid; this was warmed and the atmosphere above the suspension tested for hydrogen sulfide. The test was negative.

Hydrogen sulfide could be obtained from the flour by the addition of sulfur free zinc and hydrochloric acid. This reaction has not yet been observed with other flours which we have examined in this connection.

We have not yet determined the identity of the sulfur compound present in this flour which is reduced by the living yeast cells, but there is a possibility that the formation of hydrogen sulfide is due to the presence of sulfur or its derivatives absorbed by the flour from the fumigation of a storage warehouse with burning sulfur.

The problem is still under investigation and the writer would appreciate any information or suggestions from those who find this note a matter of interest.

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NINTH ANNUAL MEETING OF THE OPTICAL SOCIETY OF AMERICA

THE Optical Society of America met in Boston from October 23 to 25 for its ninth annual meeting. Three sessions were held at the Massachusetts Institute of Technology, two at Harvard College and one at the Boston Museum of Art.

Among the special features were addresses by Professor Ch. Fabry, of the University of Paris, on "The measurement of light"; Dr. E. R. Berry and Dr. Elihu Thomson, of the General Electric Company, on "The development of clear fused quartz"; Dr. Paul Heymens, of the Massachusetts Institute of Technology, on "Photoelasticity"; Dr. H. E. Ives, of the Western Electric Company, on "The transmission of photographs over telephone lines"; and Dr. Benjamin Ives Gilman, of the Boston Museum of Art, on "Modern solution of the problem of gallery lighting."

The following papers comprised the contributed program:

PHOTOCHEMISTRY, PHOTOGRAPHY AND GEOMETRICAL OPTICS

Report of the committee on photochemistry and photography: S. E. SHEPPARD.

On the relation between time and intensity in photographic exposure: L. A. JONES and EMERY HUSE.

A new non-intermittent sensitometer: ARTHUR C. HARDY.

Report of the committee on geometrical optics: A. E. WRIGHT.

A new instrument for the objective determination of the refraction of the eye: HERMANN KELLNER.

The chromatic aberration of fused bifocal spectacle lenses: W. B. RAYTON.

Image curvature as a function of diaphragm position: I. C. GARDNER and J. J. ARNAUD.

An instrument for the laboratory testing of binocular telescopes: G. W. MOFFITT and PAUL B. TAYLOR.

A direct system of design for the cemented two lens telescope objective: G. W. MOFFITT.

PHYSICAL OPTICS

Report of the committee on physical optics: L. R. INGERSOLL.

An analysis of the arc and spark spectra of chromium: C. C. KIESS.

Visible radiation from solid targets: PAUL D. FOOTE, W. F. MEGGERS and R. L. CHENAULT.

An improved type of illuminator for use in metallographic microscopy: LEWIS E. JEWELL.

The effect of variation of applied voltage, current and power on the candle-power and the spectral energy distribution of incandescent electric lamps: C. MATSUDA.

RADIATION AND PHOTOMETRY

Report of the committee on radiometry and photometry: E. C. CRITTENDEN.

A null method photoelectric photometer: L. BEHR.

Note on the least mechanical equivalent of light: HERBERT E. IVES.

A new method for spectrophotometry: L. A. JONES.

A direct reading spectrophotometer: CARL W. KEUFFEL.

The use of the D'Arsonval galvanometer in radiation measurements: EDISON PETTIT.

New measurements of planetary radiation: W. W. COBLENTZ and C. O. LAMPLAND.

COLOR AND COLOR TERMINOLOGY

An appendix to the English translation of the "Physiological Optics" of Helmholtz: DR. CHRISTINE LADD-FRANKLIN.

Report of the committee on color terminology: CHARLES BITTINGER.

The specification of color in terms of dominant wavelength, purity and brightness: IRWIN G. PRIEST, K. S. GIBSON and A. E. O. MUNSELL.

Spectral centroid relations for artificial daylight filters: K. S. GIBSON.

Applications of colors of similar appearances but different in spectral composition: Charles Bittinger.

Physiological Optics

Report of the committee on physiological optics: L. T. Troland.

On the development of a subjective method of skiascopy: Charles Sheard.

On the chromatic aberration of the eye and the chromatic variations in the interval of Sturm as determined by a subjective method of skiascopy: Charles Sheard.

The sensitivity-intensity law for equilibrium cone minuthesis: L. T. Troland and C. H. Langford.

The stability of hue under chromatic minuthesis: L. T. Troland and C. H. Langford.

Instantaneous photomicrography of the capillaries in the living human body: Charles Sheard.

Note on the subjective observation of the blood corpuscles in the retinal capillaries: Charles Sheard.

Pictorial Art and Vision

The illusion of depth from single pictures: Adelbert Ames, Jr.

Pictorial art and the physiology of vision: Adelbert Ames, Jr.

Most of these papers will appear in full in the *Journal of the Optical Society of America and Review of Scientific Instruments.*

The next annual meeting will be held at Cornell University in October, 1925.

The officers of the society are: Dr. H. E. Ives, of the Western Electric Company, *president;* Dr. W. E. Forsythe, of the Nela Research Laboratory, *vice-president;* Professor F. K. Richtmyer, of Cornell University, *secretary;* and Mr. Adolph Lomb, of the Bausch and Lomb Optical Company, *treasurer.*

F. K. Richtmyer

Cornell University

AMERICAN MATHEMATICAL SOCIETY

The two hundred and thirty-seventh regular meeting of the American Mathematical Society was held at Columbia University, on Saturday, October 25, 1924, extending through the usual two sessions. The attendance included fifty members of the society.

The secretary announced the election of the following sustaining members: Allyn and Bacon; the Babcock and Wilcox Company; Dartmouth College; the General Electric Company (patron); Ginn and Company; the Insull Interests, of Chicago (patron); Mr. E. W. Rice, Jr., of the General Electric Company; the Union Central Life Insurance Company, of Cincinnati; the University of Washington; the Western Electric Company (patron); the Westinghouse Company (patron). He also announced the election of 153 ordinary members, of whom 73 are nominees of sustaining members.

The following papers were read:

Note on a transformation of the hypergeometric series: B. H. Camp.

A new type of double sextette closed under a binary (3, 3) correspondence: Louise D. Cummings.

Reduction of Euler's equations to a canonical form: J. H. Taylor.

Necessary and sufficient conditions that every closed and connected subset of a continuous curve be a continuous curve. Second paper: H. M. Gehman.

The rotating disk: Philip Franklin.

The electric currents in a network: Philip Franklin.

On simple groups of low order: F. N. Cole.

On the roots of the Riemann zeta function: J. I. Hutchinson.

A note on regular singular points: Einar Hille.

Four methods for solving the problem of the rectangular beam: C. A. Garabedian.

Some two-dimensional loci: J. L. Walsh.

A uniqueness theorem for the Legendre and the Hermite polynomials: K. P. Williams.

On the prime divisors of the cyclotomic functions: C. M. Huber.

Functional invariants, with a continuity of order p, of one-parameter Fredholm and Volterra transformation groups: A. D. Michal.

On certain new topological invariants: J. W. Alexander.

The interpretation of non-integral exponents with notes on the theory of subponents: W. O. Pennell.

The representation of bounded functions by trigonometric integrals: Norbert Wiener.

A general type of singular points: Einar Hille.

The geometry of frequency functions: Dunham Jackson.

Elementary functions and their inverses: J. F. Ritt.

On the impossibility of solving certain differential equations in finite terms: J. F. Ritt.

On singularities in analytical physics: G. Y. Rainich.

The analytic function on a minimal surface: G. Y. Rainich.

On the gradient of a functional. Preliminary communication: Dunham Jackson.

Extension of a theorem due to Lerch: T. H. Gronwall.

On the Cesàro summability of Fourier's and Laplace's series: T. H. Gronwall.

A note concerning closed non-dense linear sets which are enumerable: J. R. Kline.

The annual meeting of the society will be held at Washington, D. C., from December 29 to 31, in affiliation with the American Association for the Advancement of Science. On this occasion President Veblen will deliver his retiring address, and Mr. Robert Henderson will deliver the second Josiah Willard Gibbs Lecture.

R. G. D. Richardson,
Secretary